Six Canadas of Climate Change: Segmenting Canadian Views on Anthropogenic Climate Change

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Abstract

There is little doubt within the scientific community about the need for immediate action to reduce the magnitude and impacts of Anthropogenic Climate Change (ACC). To reduce carbon and other greenhouse gas emissions effective climate solutions will require the engagement and collective action of millions of people and thousands of organizations in the United States and other countries including Canada. Unfortunately, the urgency understood and felt in the scientific community has not translated to wide-spread pro-environmental action from the public at large, or in adequate government policy to mitigate climate change. Effective and targeted engagement strategies to improve pro-environmental behaviors remain a challenge for policy makers and communicators.

This study applies a segmentation methodology developed for the United States (Maibach, Lesierowitz, Roser-Renouf & Mertz. 2011a) to a nationally representative Canadian audience. The segmentation places Canadians into six distinct groups, the "Six Canadas of Climate Change," based on their beliefs, motivations and policy preferences around ACC. Segmentation is a methodology borrowed from other social sciences to divide populations into distinct groups homogenous with respect to certain attributes such as beliefs, behaviors and ideology (Maibach et al., 2011a). Having identified segments allows communicators to target specific and meaningful communications targeted to groups whose beliefs, preferences and motivations are known.

The utility of this climate change segmentation tool is assessed by measuring its ability to predict respondent's willingness to support a series of greenhouse gas (GHG) reduction policies. Linear regression models are used to assess demographic variables, political views and the segmentation as predictors of GHG mitigating policy support. All of these variables are to some degree predictive, but the segmentation best explains variation in policy preferences.

There are significant differences in views on ACC between the United States and Canada. This study offers analysis of those differences and opportunities for future research to improve and target climate communications to distinct audience segments.

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Table of Contents

List of Tables

List of Figures

Terms and Acronyms

Climate Change Mitigation: "Mitigation is a human intervention to reduce the sources or enhance the sinks of greenhouse gases" (Pachauri et al., 2014, p. 4).

Discrete Emotions: distinct emotional states with unique action tendencies including the beliefs, motivations and behaviors aroused (Quick, Kam, Morgan, Montero Liberona & Smith, 2015).

IPCC: Intergovernmental Panel on Climate Change. A body consisting of thousands of scientists which collaborate to review, understand and report on the current status of climate change (Pachauri et al., 2014).

Six Americas: a segmentation developed by Maibach, Leiserowitz, Roser-Renouf & Mertz (2011a) to categorize Americans across a continuum of belief in anthropogenic climate change and their willingness to support various types and levels of pro-environmental behaviors.

Chapter I

Introduction

There is little doubt within the scientific community about the need for immediate action to reduce the magnitude and impacts of anthropogenic climate change (ACC). The IPCC in its Fifth Assessment Report notes that half of the cumulative anthropogenic carbon emissions since the beginning of the industrial revolution in 1750 have occurred in the past 40 years, with growth in population, and economic-drivers fostering the persistence of these emissions (Pachauri et al., 2014). The IPCC therefore continues to call for immediate drastic reductions in carbon emissions to mitigate further warming (Pachauri et al., 2014). To effectively reduce carbon and other greenhouse gas emissions effective climate solutions will require the engagement and collective action of millions of people and thousands of organizations in the United States and other countries including Canada. Some scientists are considering the "Anthropocene" as a new epoch functionally different than the last 11,000 years of the Holocene due to the distinct footprint being left by humans in the stratigraphic record (Waters et al., 2016). Closing the gap between the scientific consensus on ACC, and the collective beliefs and behavior required to address it, will require constructive engagement of all agents whose choices may impact the environment.

Unfortunately, the urgency understood and felt in the scientific community has not translated to widespread pro-environmental action from the public at large, or in adequate government policy to mitigate climate change. As individuals, industrial

organizations and governments pursue their own immediate self-interests, with a lack of a coordinated and agreed upon climate response, we are unlikely to make positive environmental decisions. As game theory teaches us, when agents make self-motivated choices, they may make themselves collectively worse off they had not pursued that interest in the first place (Singer, 1999). We must recognize and understand the differences in how people form beliefs from their varied backgrounds, experiences and values (Leiserowitz, Maibach & Roser-Renouf, 2009).

Despite calls to drastically reduce greenhouse gas (GHG) emissions, the United States and Canada are amongst the highest emitters of GHGs per capita (Pachauri et al., 2014). Specifically, from fossil fuel use, the United States is the second highest emitter of GHGs and Canada is the ninth (Olivier, Janssens-Maenhout, Muntean & Peters, 2014). Climate change is a wicked problem "that defies resolution because of the enormous interdependencies, uncertainties, circularities, and conflicting stakeholders implicated by any effort to develop a solution" (Lazarus, 2008, p. 1159). Nations and institutions attempting to mitigate climate change "face a financial disincentive to solving the problem….with no central authority that has the ability to address the problem" (Perry, 2015, p. 3). Thus wicked problems are outside of the control of any single entity and thus require mutual commitment and action from multiple groups, institutions, corporations, levels of government and individuals.

Meanwhile an organized campaign of denial and misinformation has further hampered movement toward pro-environmental behaviors (Dunlap, 2013). Climate science denial appears to be on the rise in and it appears to be aligned with partisan political ideologies (McCright, Dunlap & Xiao, 2014). Therefore, finding a way to

combat politically driven skepticism on ACC, through effective targeted science and value-based communication, is essential for encouraging more pro-environmental behaviors.

A variety of studies have measured extent of belief in ACC in the United States and elsewhere including Canada. Lachapelle, Borick & Rabe (2014) for example found that in 2013 a full 81% of Canadians believed the Earth is warming compared to 61% in the United States. As to whether they believe it is attributable to human causes rather than purely natural ones the number of Canadians drops to 51%, and the number of Americans drops to 40% (Lachapelle et al., 2014). A Pew Research Centre (2013) study found that only 40% of Americans see climate change as a major threat, while 54% of Canadians, and an average of 54% of individuals across all other countries surveyed, see global warming as a major threat. Over 97% of scientific peer-reviewed research, on the other hand, supports that the Earth is warming, and the cause is anthropogenic (Cook et al., 2013). There is thus a division of opinion between the scientific community and the general public on the seriousness and etiology of climate change. Improving widespread understanding of anthropogenic impacts on the climate are crucial for building sufficient political will to mitigate climate change (Bliuc et al., 2015).

Forming Beliefs on Climate Change

Organized science denial is not the only barrier to effective pro-environmental policy and behaviors. With the lower level of acceptance of ACC in the United States much of the research on climate science skepticism appears to be focussed there, with little comparable research in Canada. A variety of contextual factors impact how we form

beliefs on climate change beyond the information itself (Lu & Schuldt, 2015). A significant amount of research has gone into understanding how people in particular are divided on the issues of ACC based on political ideology, religious identification, moral values and level of scientific understanding.

Political Ideology

In the United States acceptance of climate science has been closely aligned with political ideology. Ideologically driven campaigns have attempted to deny the reality of ACC by manufacturing uncertainty in the science (Dunlap, 2013). These contrarian campaigns have been largely driven by fossil fuel interests and conservative think tanks (Dunlap, 2013). They have also been heavily supported by carbon-based industries (Boykoff, 2015), which like other environmentally regulated industries such as mining, utilities and chemicals, have made significant endorsements to conservative political parties such as the Tea Party (Hamilton & Saito, 2015).

These campaigns appear to be working as there is increasing public perception that scientists disagree on climate change (McCright et al., 2014). According to Borick, Lachapelle and Rabe (2011) partisan affiliation is the biggest predictor on beliefs on ACC in the United States. Conservative voters in the United States are less supportive of energy efficient technologies than their more liberal counterparts, and they are less likely to spend money on energy-efficient products (Gromet, Kunreuther & Larrick, 2013). Interestingly, the increase in climate science denial is also more prominent amongst conservative white males than other demographic groups (McCright & Dunlap, 2011).

Dunlap (2013) describes the ACC denial continuum with those in complete denial on one end, who will hold their beliefs regardless of evidence, and those who are at least open to a dialogue on the merits of the science on the other end. Amongst conservatives in the United States, Tea Party supporters were significantly less likely than non-Tea Party Republicans to trust scientists on environmental issues or to believe in ACC (Hamilton & Saito, 2015). Despite this, according to Hamilton and Saito (2015), Tea Party supporters are more confident in their climate views than other Republicans are, and less likely to be swayed by scientific evidence.

This finding is not restricted to the United States. A meta-analysis of close to 200 studies and polls from 56 nations found that political ideology was the largest demographic correlate for climate change belief (Hornsey, Harris, Bain & Fielding, 2016). Partisan divides are similar in Canada with more left-leaning voters being more likely to accept ACC than their more conservative counterparts (Lachapelle et al., 2014). Canada's recently overturned Conservative government, led by Stephen Harper, led two reframing initiatives to rebrand Alberta's oil sands as "ethical oil" and to label environmentalists as "radicals" (Gutstein, 2015). According to Gutstein (2015), the Harper government promoted an "anthropocentric" view where the world exists for human consumption, as opposed to the "ecocentric" view held by environmentalists that advocates for the flourishing of all species. It is therefore not surprising that oil-rich Alberta and the prairie provinces have some of the lowest rates of belief in climate change in Canada (Mildenberger et al., 2016).

In Australia, Unsworth and Fielding (2014) found that people were more likely to be polarized on ACC when their political affiliation was salient. In other words, when put

into the context of their political alliances, individuals, particularly on the right-end of the spectrum, were more likely to diverge from the science of ACC and align with the ideology of their party. But, when not thinking about their political identity they were more likely to be open to accepting ACC. The polarization for left-wing respondents was more negligible in this study, leading the authors to suggest that this phenomenon is more prominent for conservatives (Unsworth & Fielding, 2014).

According to McCright, Dunlap & Marquart-Pyatt (2016) the European Union (EU) has seen a similar left to right divide in views on climate change. These authors found that in Western European countries, those on the left of the political spectrum were more likely to believe in ACC, perceive it as a problem, and be willing to accept the costs of addressing it. This finding was not significant in former communist countries within the EU, however (McCright et al., 2016). Dubbed the "post-communist effect," citizens in these countries do not consistently connect environmental beliefs to political and social identities as much as they do in the western countries (Chasity & Whitefield, 2015). Thus, with few exceptions, right-wing political ideology is a significant predictor of diminished climate change belief in many of the world's developed nations.

Religious Identification

In his 2006 book *The Creation,* E.O. Wilson made a plea to evangelical Christians in the U.S. to embrace a moral responsibility to take care of the Earth (Wilson, 2006). Written as a letter to a Baptist Minister, Wilson acknowledges that while science and religion have different views on Earth's beginnings or genesis, we share a common moral duty to preserve it to sustain human life. However, in the United States at least, religious

values have not necessarily translated to an acceptance of climate change or a moral duty to care for the Earth.

In 2007, the National Association of Evangelicals (NAE) endorsed the Evangelical Climate Initiative, an initiative to mitigate carbon emissions through market forces (Chaudoin, Smith & Urpelainen, 2014). In the same year, however, the Southern Baptist Convention proclaimed:

> That we consider proposals to regulate CO2 and other greenhouse gas emissions based on a maximum acceptable global temperature goal to be very dangerous, since attempts to meet the goal could lead to a succession of mandates of deeper cuts in emissions, which may have no appreciable effect if humans are not the principal cause of global warming, and could lead to major economic hardships on a worldwide scale (Southern Baptist Convention, 2007, para. 24).

Amongst American evangelicals there has been a distrust of initiatives requiring international cooperation (Chaudoin et al., 2014), which present an issue for climate change communicators. People of faith may view the climate to be in the hands of God, and may question whether they truly can or should interfere with a divine hand.

With his encyclical in June of 2015, Pope Francis called for a new dialogue between religion and science for how we shape our planet, arguing it is a moral imperative to take care of the Earth (Francis, 2015). In *Laudato Si*, Francis (2015) calls for universal solidarity to overcome the challenges of climate change in spite of its many obstacles that include both concerted opposition and a widespread apathy. He cautions against having blind faith in technology to solve this problem, and urges a new dialogue for universal action (Francis, 2015). This reframing of global warming as a religious issue has not been confined to Catholics, as some leaders in the Evangelical-Christian, Jewish, Muslim and Episcopal communities too have recently communicated this to their members (Roser-Renouf, Maibach, Leiserowitz, Feinberg & Rosenthal, 2016).

Just prior to Francis' encyclical Roser-Renouf et al. (2016) set out to evaluate how Americans view climate change in terms of their moral and religious values. In a survey conducted in the spring of 2015 they found that while a majority of Americans consider themselves highly religious or spiritual, only a small percentage of the population sees global warming as a religious (10%) or spiritual (13%) issue. These researchers found that the American public varies widely in its views on climate change. They further found that some segments of the American population would weigh a religious explanation higher than a scientific one if the two are at odds, and a smaller segment said they would choose the scientific one (Roser-Renouf et al., 2016). Messaging from religious leaders therefore offers potential hope for climate change communicators looking for a path to convince a population that may otherwise be skeptical. It remains to be seen whether this new plea from Pope Francis for environmental stewardship translates to sustained modified behaviors from followers in the future, as is whether the climate-denial machine will alter its climate communications to adapt to this framing, as it is surely contrary to capitalist free-market ideology.

Level of Scientific Knowledge

While past research has shown that climate change skepticism may be partially attributed to a gap in knowledge, it is well known that this is far more complicated than insufficient education efforts (Corner & Groves, 2014). A recent survey of American teachers found that only 30% of middle school and 45% of high school teachers knew the correct extent of scientific consensus on anthropogenic climate change (Plutzer et al., 2016). This same study found that science teachers had limited training on climate

change, lacked specific knowledge on a wide range of evidence, and in a small number of cases, felt pressured to teach one way or another. Thus, some teachers felt a need to teach "both sides" due to their own lack of understanding and to appease views held by parents, administrators and the community (Plutzer et al., 2016).

If people make poor environmental choices due to a lack of scientific literacy, then we would expect to see beliefs and behaviors improve with increasing science education. This finding has not held in practice as studies have shown that even scientifically educated people may fail to make informed decisions about climate change. Sterman (2008) found that a group of highly scientifically educated people demonstrated a lack of understanding of basic climate dynamics. Kahan et al. (2012) found that technical reasoning capacity and scientific literacy were not predictive of concern for climate change. They found instead that humans are well-equipped to use their knowledge and reasoning ability to advance their self-interests and support their existing views (Kahan et al., 2012). Hornsey et al. (2016) reported that overall education did have a small positive effect in predicting belief in climate change.

Beyond basic awareness, public engagement must acknowledge that understanding of ACC is embedded in linguistic and cultural values and norms (Hanson-Easy, Williams, Hansen, Fogarty & Bi, 2015). People may shy away from evidence if that evidence leads to outcomes that are not desired or favorable (Leiserowitz, Maibach, Roser-Renouf & Feinberg & Howe, 2013). For those who are not climate scientists the communication they receive on climate science is typically mediated through other institutions they may or may not identify with and thus those communications may come with other competing values and beliefs (Corner & Groves, 2014). Engagement efforts

should therefore not only reduce the gap in scientific knowledge, but also between its impacts and personal values (Scannell & Gifford, 2013). It is perhaps questionable whether detailed understanding of the technical aspects of global warming is necessary for public support of environmental protection, or whether communication efforts should be focussed on other influencers on the human decision making process.

Reasoning

Taking knowledge a step further, some social psychologists have investigated our ability to reason as a factor in our decision making around climate change and other issues. After reviewing extensive past research on motivated reasoning, Mercier and Sperber (2011) conclude that reasoning's function is to persuade, rather than to find truth, leaving humans susceptible to misinformation. They argue that while "reasoning is generally seen as a means to improve knowledge, and make better decisions…it often leads to epistemic distortions and poor decisions" (Mercier and Sperber, 2011, p.57).

Haidt (2012) has come to a similar conclusion: "Anyone who values truth should stop worshipping reason" (p.104). After years and multiple studies Haidt, a moral psychologist, has tried to understand how presumably equally rational individuals can be so polarized on topics such as politics, religion and climate change. Haidt argues that morality is the key to understanding humanity. He defines moral systems as "interlocking sets of values, virtues, norms, practices, identities, institutions, technologies, and evolved psychological mechanisms that work together to suppress or regulate self interest and make cooperative societies possible" (p. 292). His research has led him to argue that it is in fact our intuitions that drive our moral actions and not our

reasoning. He provides a metaphor of the mind being an elephant (intuition), served by its rider (reason), rather than the other way around. The rider, according to Haidt, is much like a press secretary serving their president – using reason to get through difficult questions to support an agenda, or to defend prior decisions or behaviors (Haidt, 2012).

The conclusions of psychologists such as Mercier, Sperber and Haidt may be open to debate. Their work however does lend support to the notion that humans are complex in the way we process information, form beliefs and make decisions to serve our interests and values. Knowledge and reason alone may not be enough to persuade skeptics and doubters to accept the conclusions of scientists, when an internet search can readily reveal contrarian information or "evidence" that supports their firmly held beliefs (Haidt, 2012). Thus fact-supporting charts, figures, graphs and data, no matter how scientifically sound, may be of little value to promoting pro-environmental behaviors in climate change skeptics. For that reason it is arguably important for climate change communicators to have a greater understanding of their audience and to know what motivates their values and decision making.

This is not to imply that things are hopeless, or that there is no value in reason. Unbiased reasoning is simply more likely to occur when individuals sincerely seek the truth rather than to win the debate (Mercier & Sperber, 2011). Thus if reason and knowledge are not enough, we need to better understand how people inform their views and behaviors, and perhaps to whom we are talking to when targeting our communications, or trying to steer the elephant.

Emerging Research

While how we frame beliefs on ACC can be linked to the salience of our political, moral and religious beliefs, another line of reasoning suggests that ACC is better understood as an intergroup conflict between believers and skeptics, rather than between scientists and certain members of the public (Bliuc et al., 2015). These two groups have "distinct social identities, beliefs and emotional reactions that systematically predict their support for action to advance their respective positions" (Bliuc et al., 2015, p. 226). Thus according to these authors while beliefs on ACC, or for that matter, gay marriage, abortion or gun rights, may emerge from political, moral and religious beliefs, they cannot be simply reduced to them.

An interesting new area of research has emerged proposing that in addition to the political, religious and moral values we hold, our belief in ACC can also be informed or altered through discreet or incidental emotions. Discrete emotions are typically one-word emotions such as fear, worry, anger or guilt (Lu & Schuldt, 2015; Smith & Leiserowitz, 2014) and can be defined as distinct emotional states with unique action tendencies including the beliefs, motivations and behaviors aroused (Quick et al., 2015).

It is accepted in social sciences that these types of emotions may influence attitudes, intentions and behaviors (Yoo, Kreuter, Lai & Fu, 2014). Lu and Schuldt (2015) investigated how the emotions of guilt and anger could mitigate support for proactive climate policy. In their study they assigned participants to one of two emotion based treatments (guilt or anger) and then measured their willingness to support an environmental policy. They found that guilt significantly led to increased willingness to support environmental policy compared to controls, while there was no such finding with

anger. Smith and Leiserowitz (2014) found that worry, hope and interest had a positive impact on support for pro-environmental policy. They found that discreet emotions had greater strength for modifying willingness for policy support than cultural views, negative affect or socio-demographic variables (Smith & Leiserowitz, 2014). Further research is required for understanding how each of these emotions can impact attitudes toward climate policy and more specifically, how different groups of people will react to each emotion.

Audience Segmentation

To better understand how the general American views the issue of climate change, a group of researchers at Yale University and George Mason University (herein referred to as "the Yale Team") have conducted repeated national surveys since 2008 (see most recently Roser-Renouf et al., 2016). These studies have additionally asked Americans about their climate related behaviors and policy preferences for mitigating ACC. In their research they have found that there are in fact six distinct segments of Americans who differ in their views on climate change, on a relative continuum of full belief in ACC through to denial. These "Six Americas of Climate Change" are the Alarmed, Concerned, Cautious, Disengaged, Doubtful and Dismissive with the first four being accepting of climate change to some degree the and the remainder ranging from doubtful to denial. The survey was first put in the field in 2008 (Leiserowitz, Roser-Renouf & Smith, 2009) and has been repeated several times. This has allowed the Yale Team to monitor changes in segments over time. It is also a useful framework for

measuring ongoing shifts in climate change attitudes, as well as acceptance of climate policy amongst Americans.

The Yale Team argues that given that people vary in their experiences, values and knowledge, it is important to "know thy audience" in devising effective communication strategies for engaging the various segments in positive environmental behaviors (Leiserowitz et al., 2009). They point out we must understand how individuals in each of these distinct segments perceives the threat of climate change, what they currently believe in the science, how they intend to act and what their current policy preferences are. Armed with this knowledge, we can the devise communication strategies to promote better individual decision-making and support, for advancing systemic change to manage this issue (Leiserowitz et al., 2009).

Segmentation research is not new and has previously been used in areas such as public health and political strategy. Behavioral scientists have long known that people will respond uniquely to varying messages and motivators, depending on their own experiences and values (Hornik, 2002). Political strategists have also used this information to isolate messaging to specific groups of voters to maximize returns on their campaign efforts (Sosnik, Fournier & Dowd, 2007). More recently, social media companies use segmentation methodologies to target specific ads and content based on users' behaviors and online profiles (Hine et al., 2014). Given the differences in human values, beliefs and behaviors, climate science communicators can ill afford costly communication strategies that are not tailored to their audience. Audience segmentation therefore offers the ability to identify distinct groups of people who vary in their beliefs

and motivations, and to whom specific targeted communications may be more meaningful (Leiseowitz et al., 2009).

Segmentation in the American Context

The research by the Yale Team showed how the six distinct segments of Americans differ in the following ways on climate change: beliefs and issue involvement; expected outcomes from action to reduce global warming; policy and national response preferences; personal actions and intentions; demographics, social characteristics and values, and; media use and information sharing. According to Leiserowitz et al. (2013) the Alarmed (12%) are the most concerned about global warming, believe it is primarily human-caused, and are the most likely to take action or support environmental policy. The Concerned (29%) agree that climate change is a serious issue that needs immediate attention, but they are not as likely as the Alarmed to take personal action. The Cautious (26%) believe that global warming is happening, but they do not see it as an immediate threat and do not believe that any immediate action is necessary. Moving further to the right on the continuum the Disengaged (7%) do not give much thought to whether or not it is happening but members of this group are the most open to changing their views. The Doubtful (15%) meanwhile are not certain whether global warming is happening but believe that if it is, the causes are a natural climatic cycle that has little to do with human activity. Finally, the Dismissive (11%) believe that global warming is not happening and like the Alarmed are the most likely to be active in promoting their beliefs and taking action on the issue (characterizations from Leiserowitz et al., 2013; percentages from

Roser-Renouf et al., 2016). The following summarizes how Leiserowitz et al. (2013) evaluated the way in which the six Americas differ in each of these characterizations:

- Beliefs and issue involvement: the surveys examined level and certainty of belief in climate change, its personal importance, and the amount of thought and worry respondents give to the subject for themselves and future generations. Further they asked how much knowledge respondents feel they have, what the causes of climate change are and the level of scientific consensus.
- Expected outcomes from action to reduce global warming: responses from each of the six segments were collected on the expected outcomes of human action to reduce ACC including number of positive outcomes, negative outcomes and the effectiveness of personal pro-environmental actions if adopted widely. None of the segments are confident that we will reduce ACC, but a majority from the Alarmed, Concerned, Cautious and Disengaged believe that we can do so if the United States takes appropriate actions.
- Policy and national response preferences: the surveys measured support for a variety of national policies to address climate change. These included signing treaties to reduce GHG emissions, regulating CO2 as a pollutant, regulating vehicle fuel efficiency, providing rebates for purchasing solar panels or fuel-efficient cars, and support for cap and trade policies.
- Personal actions and intentions: the surveys measured personal actions taken to reduce the impacts of ACC including contacting elected officials, rewarding pro-environmental companies with spending, intentions to engage in consumer activism,

steps to improve energy consumption in the home, habitual actions to reduce carbon footprint, and number of communications with others on ACC.

- Demographics, social characteristics and values: in order to understand the six segments, the study identified basic demographic data as well as political party affiliation, religious beliefs and alignment to egalitarian values.
- Media use and information seeking: the study evaluated both the level and types of information sought including attention paid to global warming information as well as the level of trust in scientists and in the media.

This data thus enabled the authors to characterize each of the six Americas in terms of risk perceptions, how they receive information, their desired response, if any, and personal intentions with respect to the issue. Armed with this information climate change communicators can devise and test different messaging strategies that are specific and effective for each of the segments.

In the survey conducted in 2012, the Alarmed, Concerned and Cautious made up 70% of the population with the Concerned filling the largest segment at 29% (Leiserowitz et al., 2012). Thus the majority of Americans at that time supported some type of action on climate change. By monitoring over time they found that from the baseline 2008 segmentations the number of Alarmed and Concerned actually shrank by 2010 while the number of Dismissive almost doubled. By 2012 these numbers had rebounded slightly showing a gradual trend towards a greater number of believers (Leiserowitz et al., 2012). By 2015 the percentage of Alarmed, Concerned and Cautious had actually decreased again to 66%. In all surveys the two most polarized groups of Americans (Alarmed and Dismissive) are the most involved in their activities to promote

or dismiss the need for climate mitigation strategies while the other segments are less involved, if at all.

In early 2016 the Yale Team used the Segmentation methodology to identify how the Six Americas of Climate change view the issue of climate change when framed as a religious, moral or spiritual issue (Roser-Renouf et al., 2016). Using this methodology provided the Yale Team with specific insights into how the Six America individually differ on these frames. They found, for example, that while the Alarmed weighed scientific evidence over religious beliefs when the two were in conflict, the majority of the other segments would side with religion. This is valuable insight for climate change communicators to know that impassioned pleas from religious leaders, are more likely to motivate these segments than passionless charts and figures presented by scientists (Roser-Renouf et al., 2016). They similarly found that these segments differ in their egalitarian and individualistic values, which too provides clues for how to motivate specific groups in the population (Roser-Renouf et al., 2016).

Canadian and Comparative Studies

While much of the research on climate views is focussed on the United States, some studies have investigated Canadians' views on climate change. For example, Boric, Lachapelle & Rabe (2011) compared the views of Canadians and Americans for their opinion on climate change across a number of variables such as whether it is happening, its causes, and the role of the government in addressing it. They found some interesting differences between the two countries including that there is less skepticism about climate change in Canada than in the United States. Canadians were less likely to believe

that scientists are manipulating data and they found that Canadians are more willing to pay for climate mitigating measures such as cap and trade policies. Skepticism tended to be aligned to Conservative Party Affiliation in Canada, and Republican support in the US (Borick et al., 2011).

Such comparative studies are a useful tool as they help to discern broad patterns of behaviors across different societal and political landscapes (Borick et al., 2011). As each other's largest trading partners, Canada and the United States are tightly dependant on each other's policies related to climate change and mitigation (Lachapelle, Borick & Rabe, 2012). With Canada's dependence on energy markets, Canadians may experience mixed emotions with wanting to curb emissions, while simultaneously financially benefiting from the production of energy. Canada is a large emitter of CO2 and its emissions have grown more rapidly than the United States in recent years, due primarily to activity in the Athabasca tar sands (Lachapelle et al., 2012). Thus finding ways to motivate the Canadian public to support greenhouse gas-reducing policies and to embrace more pro-environmental behaviors remains a formidable challenge.

Research Questions and Significance

To my knowledge no one has yet utilized the Six Americas Audience segmentation developed by the Yale Team (Maibach et. al., 2011a) to assess segmentation of climate change views in Canada. The research question this thesis will address is, utilizing the methodology of the Six Americas, are Canadians similarly segmented on climate change beliefs as Americans? Secondly, the usefulness of this segmentation will be tested by using the segment membership to predict the level of

support for various greenhouse gas reducing strategies. Third, demographic variables will be used as predictors of policy support and as comparators to the usefulness of audience segmentation.

This framework could provide a useful comparison of views on climate change between these two large trading partners. It will also provide a baseline moving forward so that the views of these distinct groups of Canadians have on climate change and climate policy can be monitored over time. Having a comparator country will support future research to understand what factors contribute to stronger segmentation in either country, and thus how climate communication efforts can be tailored to specific groups. With Canada's different political party framework this research will help identify how supporters of Canada's multiple political parties view various climate policies. With Canada and the United states both being significant greenhouse gas emitters there are significant opportunities for effective harm reduction strategies. Understanding how Canadians are segmented in their views on climate change could inform the development of climate communications that can be targeted to the beliefs and behaviors of each of these segments in Canada. Climate communicators can thus test the effectiveness of various strategies on each segment in an attempt to improve personal behaviors and increase support for institutional change. Haidt (2012) proclaims that theories are cheap, but only once they are empirically tested can we begin to understand why we may have such drastically different views on objective facts than our neighbours.

Chapter II

Methods

In order to characterize Canadians' views on climate change I utilized the Six Americas segmentation tools provided by Maibach, Leiserowitz, Roser-Renouf, Mertz and Akerlof (2011b). These tools were made available by these investigators to support the implementation of this methodology in other jurisdictions, and to further the reach of the research. The methods are fully described by Maibach et al. (2011a) in a separate article. Audience segmentation methodology is widely supported in other fields where effective public engagement is required to shape behaviour, including political science and public health (Maibach et al., 2011a).

Survey Design

The investigators in the Six Americas study utilized a 36-question segmentation tool using a linear discriminant function that correctly identified 90.6% of the sample (Maibach et al., 2011a). The complete Six Americas survey is large and took an average of 50 minutes per respondent, which includes the 36 question audience segmentation, as well as the collection of policy preferences and demographic information. By eliminating 21 of the least predictive variables from the audience segmentation questions, the investigators also developed a "reduced discriminant model" that correctly predicts 83.8% of the sample (Maibach et al., 2011a). In order to mitigate scope and funding considerations for this research, I used the 15-question reduced discriminant model.

Some references in the 15 questions were specific to the United States. The questions were therefore modified to meet the Canadian context. For example, one question referenced the United States, its President and Congress. That reference was changed to reflect the parliamentary system of government in Canada. I do not believe that the change in wording altered the meaning of the question significantly. The questions asked (along with the original Six Americas questions, when different) are shown in the Appendix.

The complete survey in this study had 33 questions in total. The first 15 questions are the reduced discriminant model segmentation questions. The subsequent nine questions were designed to predict the usefulness of the segmentation, and again followed the wording and methodology in Maibach et al. (2011a). These nine questions measured policy preferences on initiatives to reduce greenhouse gas (GHG) emissions. Respondents were asked on a four-point scale whether they Strongly Agree (4), Agree (3), Disagree (2) or Strongly Disagree (1) with the proposed policy initiative. It is hypothesized that respondents will be less agreeable to such policies as they move along the continuum of segments from the Alarmed through to the Dismissive. The responses to these nine questions were averaged into a single index of policy support, named the GHG Policy Index. Using this index as an outcome measure, regression models were created to test the predictive ability of the segmentation for GHG policy support, compared to other demographic variables.

The final nine questions on the survey requested demographic information from the respondents. These questions included age, gender, province of residence, income, employment status, education level, ethnicity, political ideology and voting behavior in

the last Canadian federal election. These characteristics will shed some light on whether certain demographic variables are predictive of support for GHG reduction polices, and provide a comparison to the usefulness of the audience segmentation to explain variance in support for GHG policies. In the fall of 2015 Canada had a federal election where climate policy was a source of difference between the ruling Conservative Party and the major opposition parties. This created an opportunity to assess whether voting behavior in the last federal election was a predictor of support for GHG reduction policies.

Ethical Research Guidelines

To ensure this study met ethical research guidelines it was submitted to the Committee on the Use of Human Subjects at Harvard University. The target audience for this survey were adults in the Canadian population. No personally identifiable information was shared between the respondents and the researcher. Participation was voluntary and all participants provided their consent to continue in the survey. The Committee on the Use of Human Subjects determined that the nature of the study was no greater than minimal risk and that it met exemption status.

Distribution and Participant Selection

In order to get a representative sample of Canadians, the Leger Web Panel (Legerweb) was utilized to have a distribution channel capable of delivering a sufficient number of surveys across the country. Legerweb is the largest Canadian web panel with 400,000 active and representative members across Canada (Leger, 2016). To determine an appropriate sample size for a representative sample of Canadians, an online population

calculator was used. With a population size of 35,851,000 (Statistics Canada, 2015a) a margin of error of 5% and a confidence level of 95%, the online Survey Monkey Sample Size Calculator (Survey Monkey, 2015) determined that 385 samples would be needed. Precisely the same result was found using Calculator.net (Calculator.net, 2015).

The survey was distributed across Canada from February 11, 2016 to February 15, 2016. Only respondents over the age of 18 who consented to the survey were allowed to participate. Respondents were given the option to skip any questions they preferred not to answer.

The methodology described in Maibach et al. (2011a) requires that responses missing more than 20% missing data for the segmentation questions should be discarded. Thus although only 385 final samples were needed for a representative sample, a target of 500 samples was utilized to ensure sufficient (>80%) completed surveys. A series of chi-square tests were used to compare the age, gender and geographic region of the respondents to the predicted Canadian adult population values to validate that the survey was nationally representative.

The first question in the survey (question zero) was a consent form, approved through the ethics review process. Respondents were asked to select that they voluntarily agreed to take part in the questionnaire by electing “Yes,” or that they did not want to continue by selecting “No”. Respondents who selected “No” were then excluded from continuing in the study.

Data Analysis

The data collected through the Leger Panel was provided in SPSS format. The consent question prevented any non-consenting subjects from being included in the data set. Participants were given the option to not answer questions, which allowed for missing data. For consistency with the Six America's study, the missing data for the first 15 segmentation questions was replaced according to the rules set out by Maibach et al. (2011b). The missing data rules from that study are provided in the Appendix. That study primarily used mean substitution, which is prone to bias. As noted and discussed in the Results chapter below, only a small number of samples were recoded this way. The same methodology was used for missing data in the GHG policy questions.

The responses to the first fifteen questions on audience segmentation were analyzed in SPSS using the script and toolkit provided by Maibach et al. (2011b). This process grouped the respondents into the six segments of climate belief – the Alarmed, the Concerned, the Cautious, the Disengaged, the Doubtful and the Dismissive – the Six Canadas of Climate Change.

An ANOVA was completed across the six segments for each of the 15 questions to test the difference in means for the profiling questions, and to test the null hypothesis that there is no difference between segments for each question. This was done to validate the power of the questions to solicit significantly different responses between the segments.

To align with the Maibach et al. (2011a), and to ensure a basis for some comparisons, several regression models were created to test the predictive value of this

segmentation model, as well as to test other characteristics of the respondents. Using responses to the nine policy preference questions as an outcome measure (y), the regressions were then conducted utilizing SPSS. To achieve this, the mean responses were averaged for each policy question by segment. Then the responses were combined into a single (mean) "GHG Policy Index" for all of the questions. Cronbach's Alpha was calculated to test the internal consistency of the scores. Regression Model 1 evaluated demographic variables including age, gender, region, education level, income, employment status and race. A one-way ANOVA was first constructed for each of the demographic variables to test whether there was significant effect on the outcome. Those that were significant were included in the regression, while the rest were excluded from further evaluation. Significant categorical demographic variables such as "region" were recoded into dummy variables in order to allow for the regression. Regression Model 2 evaluated the effect of political ideology as a predictor of the GHG Policy Index. In this model political ideology was assumed to be on a continuum of strongly liberal to strongly conservative. Regression Model 3 similarly evaluated voting behavior in the last Federal election in 2015 as the independent variable. Again the categorical variables indicating the supported party had to be recoded into dummy variables to allow these variables into the regression. Regression Model 4 tested the segments (Alarmed, Concerned, Cautions, Disengaged, Doubtful or Dismissive) as a predictor of the GHG Policy Index. Finally, Regression Model 5 was the full model of all the predictor variables.

To test whether Canadians are similarly segmented in their views on climate change as Americans, a chi-square test was completed. This test compared the observed number of Canadian respondents by segment, to the expected number of American

respondents for each segment based on the results of the latest Six Americas study (Roser-Ranouf, 2016).

Assumptions for Linear Regressions

To carry out the linear regressions several assumptions must be met. The survey questions, as well as the regression models, were designed to ensure that these assumptions were met. First, all variables were either designed to be continuous, or in the case of categorical variables, were coded into dummy variables to allow the regression. Second, partial regression plots were created to test the linearity between the variables. Third, scatterplots were used to visually identify whether there were significant outliers, and the Cook's distance was also evaluated. Fourth, to ensure independence of observations the Durbin-Watson statistic was calculated. Fifth, the homoscedasticity was evaluated by plotting predicted against residual values. Finally, a P-P plot was created to test that the residuals of the regression line are approximately normally distributed.

Research Limitations

There are some potential research limitations that need to be highlighted. To mitigate funding challenges, the 15-question reduced discriminate model was used rather that the full 36 question linear discriminant function. Based on the research methodology by Maibach et al. (2011a), this model is expected to correctly identify respondents into the correct segments for 83.8% rather than 90.6% of the sample. Thus it should be noted that this may account for some variance in the comparisons between Canadians and Americans, given the 36-question full discriminant model survey was used for the latter.

Some slight differences in the selection of participants between the two studies such as how participants were selected could also account for some variation in the expected variation on how correctly the tool will identify respondents. Two questions were altered very slightly to accommodate the differences in government structure between the countries. The changes were slight as noted above but should be acknowledged. The original questions from the Six Americas compared to the questions asked for the Six Canadas are shown in the Appendix.

The Leger panel was used to assist with reaching a willing audience across Canada with a sufficient sample size. There is presumably a risk that repeated panel members who voluntarily participate in multiple studies, may respond differently than members of the general population. However, a very similar type of panel was used in the Six Americas segmentation. Such panels also have advantages such as being able to ensure a somewhat representative sample across demographic variables. There is a risk of bias in the population surveyed. To evaluate whether the sample group was nationally representative for Canadian adults by gender, age and region of residence chi-square tests were used. The sample group was characterized against the latest demographic information form national census data in terms of age, gender and region of residence. The data was then compared to the Six Americas data in the United States to identify similarities and differences that may stimulate future research. The meaningfulness of that data was then discussed in the context of framing future climate communications towards improving support for pro-environmental policies and behaviors.

Chapter III

Results

A total of 553 responses were received from across Canada. All cases that had more than 20% missing data (n=2) were excluded from the analysis. The remainder with any missing data had those data variables recoded, as described by Maibach et al. (2011b) and in the Methods. Missing data was minimal with 38 of 551 respondents missing 1 (n=31), 2 (n=4) or 3 (n=3) of the 33 questions.

The Legerweb panel had the ability to distribute surveys across Canada by location, age group and gender. The relative proportions of responses by region in the survey were compared to those expected based on current population data. A chi-square test to compare area of residence of the sample group against predicted Canadian population data shows there were no significant differences between the groups ($p>0.975$; Table 1). It was noted that no responses were received from Canada's three territories – Yukon, Northwest Territories and Nunavut, though combined the population in these areas is estimated at less than 0.4% of Canada's population. A chi-square test also verified no significant differences between the sample and expected Canadian population based on age ($p>0.95$; Table 2) or gender ($p>0.80$; Table 3).

Table 1. Chi-square on relative Canadian population by region for observed sample population compared to the expected population.

	Observed		Expected		
Province/Territory	% of Total	Respond-ants	2015 % Population*	Expected Population	Chi-square
Alberta & Territories (YK, NT, NU)	10.9	60	12.0	66	0.57
Atlantic (NB,NL,NS,PEI)	6.9	38	6.6	36	0.07
British Columbia	13.2	73	13.1	72	0.01
Ontario	38.9	214	38.5	212	0.02
Prairie (MB,SK)	6.7	37	6.8	37	0.01
Quebec	23.4	129	23.0	127	0.04
Totals**:**	100	551	100	551	0.71

At 5 degrees of freedom, p>0.975
*Source (Statistics Canada, 2015b)

Table 2. Chi-square on relative Canadian population by gender for observed sample population compared to the expected population.

	Observed Sample		Expected		
Gender	% of Total	Respond-ants	2015 % Population (>18 years)*	Expected Population	Chi-square
Female	48.8	269	49.2	271	0.02
Male	51.2	282	50.8	280	0.02
Totals**:**	100	551	100	551	0.03

At 1 degree of freedom, p>0.95
*Source (Statistics Canada, 2015a)

Table 3. Chi-square on relative Canadian population by age group for observed sample population compared to the expected population.

	Observed Sample		Expected		
Age Group	% of Total	Respond-ants	2015 % Population*	Expected Population	Chi-square
18-24	10.3	57	11.5	63	0.64
25-34	16.2	89	17.2	95	0.35
35-44	16.9	93	16.5	91	0.05
45-54	19.8	109	18.0	99	0.97
55-64	17.2	95	16.8	93	0.06
65+	19.6	108	20.0	110	0.04
Totals**:**	100	551	100	551	2.12

At 5 degrees of freedom, $p>0.80$

*Source (Statistics Canada, 2015a)

The segmentation script provided by Maibach et al. (2011b) was applied using SPSS and the "Six Canadas of Climate Change" were determined - The Alarmed (21%), The Concerned (40%), The Cautious (26%), The Disengaged (2%), The Doubtful (6%) and The Dismissive (5%) (Figure 1).

An ANOVA across the six segments for each of the 15 questions tested the between-segment difference in means for each of the reduced discriminant tool audience segmentation questions (Table 4). For each question, the between-segment differences were significant ($p<0.001$). The mean responses were calculated by segment for each of the 15 profiling questions (Table 5).

The responses to the nine GHG policy preference questions (4= Strongly Support) were averaged for each segment (Table 6). As in Maibach et al. (2011a) the policy questions were averaged into a single GHG Policy Index by segment to be used as the

outcome measure (y) for the regressions (bottom of Table 6). The policy scale had a Cronbach's alpha of 0.90.

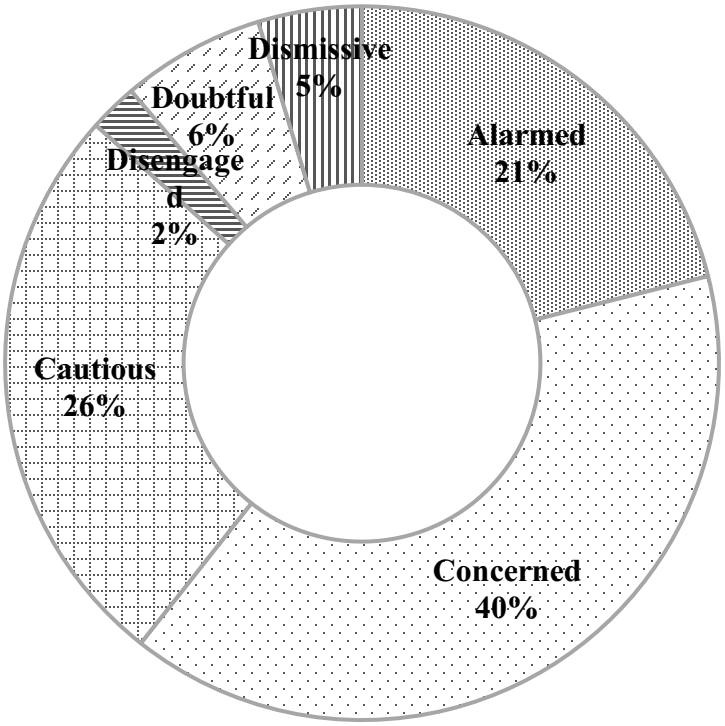

Figure 1. The Six Canadas of climate change –How Canadians are distributed in beliefs on climate change.

Table 4. ANOVA with difference in means between each reduced discriminant model audience segmentation question.

Segmentation Question	Segment	df	F	Sig. (p)
Q1.	Between	5	89.285	0.001
	Within	545		
Q2.	Between	5	56.839	0.001
	Within	545		
Q3.	Between	5	173.238	0.001
	Within	545		
Q4.	Between	5	78.780	0.001
	Within	545		
Q5.	Between	5	112.533	0.001
	Within	545		
Q6.	Between	5	199.165	0.001
	Within	545		
Q7.	Between	5	37.862	0.001
	Within	545		
Q8.	Between	5	167.717	0.001
	Within	545		
Q9.	Between	5	51.979	0.001
	Within	545		
Q10.	Between	5	21.628	0.001
	Within	545		
Q11.	Between	5	65.763	0.001
	Within	545		
Q12.	Between	5	110.378	0.001
	Within	545		
Q13.	Between	5	32.064	0.001
	Within	545		
Q14.	Between	5	170.474	0.001
	Within	545		
Q15.	Between	5	5.734	0.001
	Within	545		

*See Appendix 1 for detailed questions

Table 5. Mean responses to profiling questions by segment.

Survey Question	Segment						Scale
	Alarmed	Concerned	Cautious	Disengaged	Doubtful	Dismissive	
Belief and Issue Involvement questions							
1. Certainty of global warming	8.63	8.06	6.90	5.67	5.42	3.38	9
2. Human Cause (% agree)	91.4	87.1	53.1	58.3	2.8	7.7	100
3. Worry about warming	3.72	3.20	2.62	2.00	1.69	1.19	4
4. Personal harm from	3.31	2.66	1.96	1.00	1.36	0.96	4
5. Timing of harm to	5.46	4.94	3.67	3.92	1.61	1.23	6
6. Harm to future generations	3.95	3.75	2.80	0.33	1.92	1.00	4
7. Prior thought to global	3.69	3.03	2.59	2.00	2.69	2.77	4
8. Personal importance of global warming	4.22	3.27	2.50	2.50	1.72	1.19	5
9. Unwilling to change opinion	3.65	2.88	2.29	2.17	2.86	3.23	4
10. Friends share views on global warming	3.60	3.02	2.49	2.33	2.89	3.23	5
11. Ability of humans to mitigate warming	3.72	3.65	3.19	3.83	2.19	1.73	5
Behavior Questions							
13. Punished companies for not reducing emissions	2.88	1.33	1.28	0.67	0.97	1.15	5
Preferred Societal Response Questions							
12. People should do more/less to reduce warming	4.64	4.11	3.53	3.58	2.67	2.00	5
14. Priority for Parliament and Legislatures	3.61	2.78	1.98	2.08	1.25	1.04	4
15. Conditions for Canadian action (% regardless of actions of other countries)	93.1	81.2	53.1	58.3	25.0	19.2	100

Between segment means ($p<0.001$)
Descriptions from Maibach et al. (2011a)

Table 6. Mean responses to greenhouse gas reduction policy questions by segment.

Policy Preference	Segment						Scale
	Alarmed	Concerendd	Cautious	Disengaged	Doubtful	Dismissive	
Belief and Issue Invovement questions							
16. Establish special fund to help make buildings more energy-efficient and teach Canadians to reduce energy use. Adds $2.50 surcharge to average household's monthly electric bill.	3.10	2.64	2.18	2.08	1.53	1.27	4
17. Government subsidy to replace old water heaters, air conditioners, light bulbs, and insulation. Cost to average household is $5/mo in taxes but with savings on utility bills.	3.28	2.78	2.28	2.67	1.81	1.69	4
18. Adopt a carbon tax scheme for all polluters of carbon	3.39	2.79	2.35	3.00	1.61	1.35	4
19. Require electric utilities to produce at least 20% of electricity from wind, solar, or other renewable energy sources, even if it cost the average household an extra $100 a year.	3.09	2.60	2.14	2.42	1.50	1.19	4
20. Sign an international treaty that requires Canada to cut its emissions of carbon dioxide 90% by the year 2050.	3.50	2.98	2.35	2.83	1.81	1.35	4
21. Require automakers to increase fuel efficiency of cars, trucks, and SUVS, to 45 mpg, even if new vehicle will cost up to $1,000 more to buy.	3.56	3.02	2.61	3.00	2.25	1.85	4
22. Fund more research into renewable energy sources like solar and wind.	3.65	3.31	2.99	3.00	2.67	2.04	4
23. Tax rebates with purchase of energy-efficient vehicles or solar panels.	3.59	3.30	2.94	3.08	2.86	1.88	4
24. Increase taxes on gasoline by 8 cents/L but return revenues to taxpayers through reduced federal income tax.	2.95	2.36	2.22	2.33	1.75	1.73	4
GHG Policy Index	3.35	2.86	2.44	2.70	1.97	1.59	4

Descriptions from Maibach et al. (2011a)

Regression Assumptions

Before completing the regressions, the data were examined to ensure they met the necessary assumptions for a linear model. First, the data variables had to be measured at a continuous level. The survey questions were designed to ensure that the data were continuous. The dependent (y) variable, the GHG Policy Index, was the mean of responses by segment from a 4-point continuous scale (Table 6). The independent (x) variables were either continuous on a sliding scale or categorical. When categorical variables were used, such as province or political party, they were recoded to dummy-variables to allow for the regression.

Second, partial regression plots were created between each of the independent variables (x) and the GHG Policy Index (y) and examined for linearity. The scatterplots for each of the independent variables were produced for Gender and Education (Figure 2), Province/Region (Figure 3), Political party an Political Ideology (Figure 4), and Audience Segment (Figure 5). A visual inspection confirms that the relationship between the independent variables and the GHG Policy Index appear linear. (Note that in the figures "PREF_Index" is the name of the GHG Policy Index.)

Third, to ensure that there were no significant outliers, scatterplots were created of the GHG Policy Index compared to the predicted regression using SPSS and visually inspected. A visual inspection revealed no significant outliers (Figure 6).

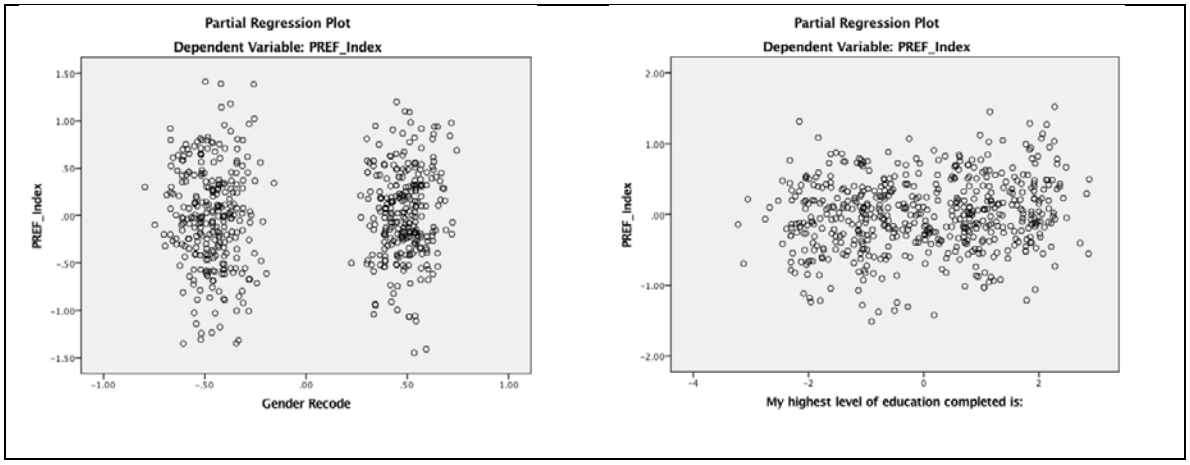

Figure 2. Partial regression plots for gender and education level against GHG Policy Index.

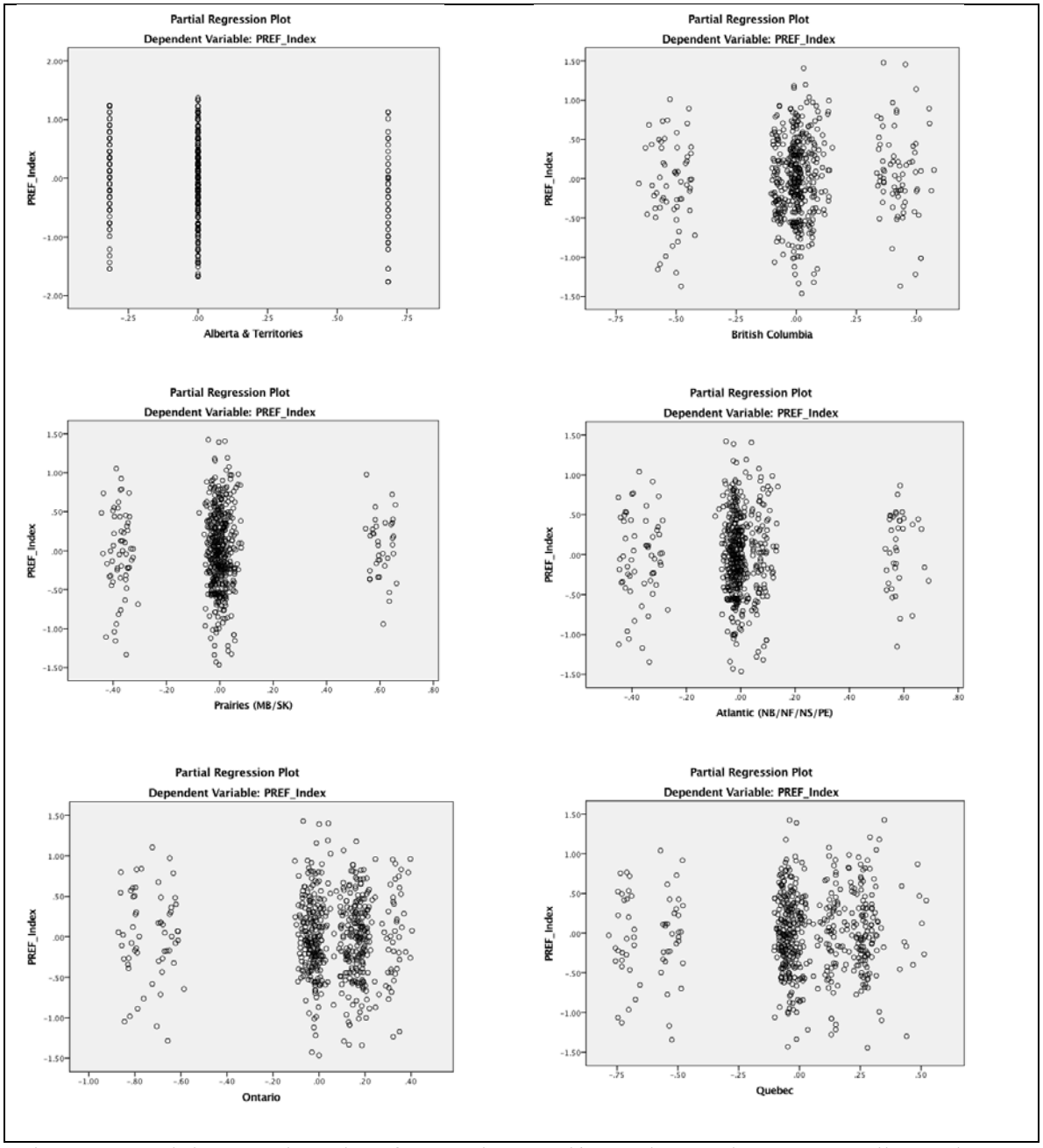

Figure 3. Partial regression plots for province and/or region against GHG Policy Index.

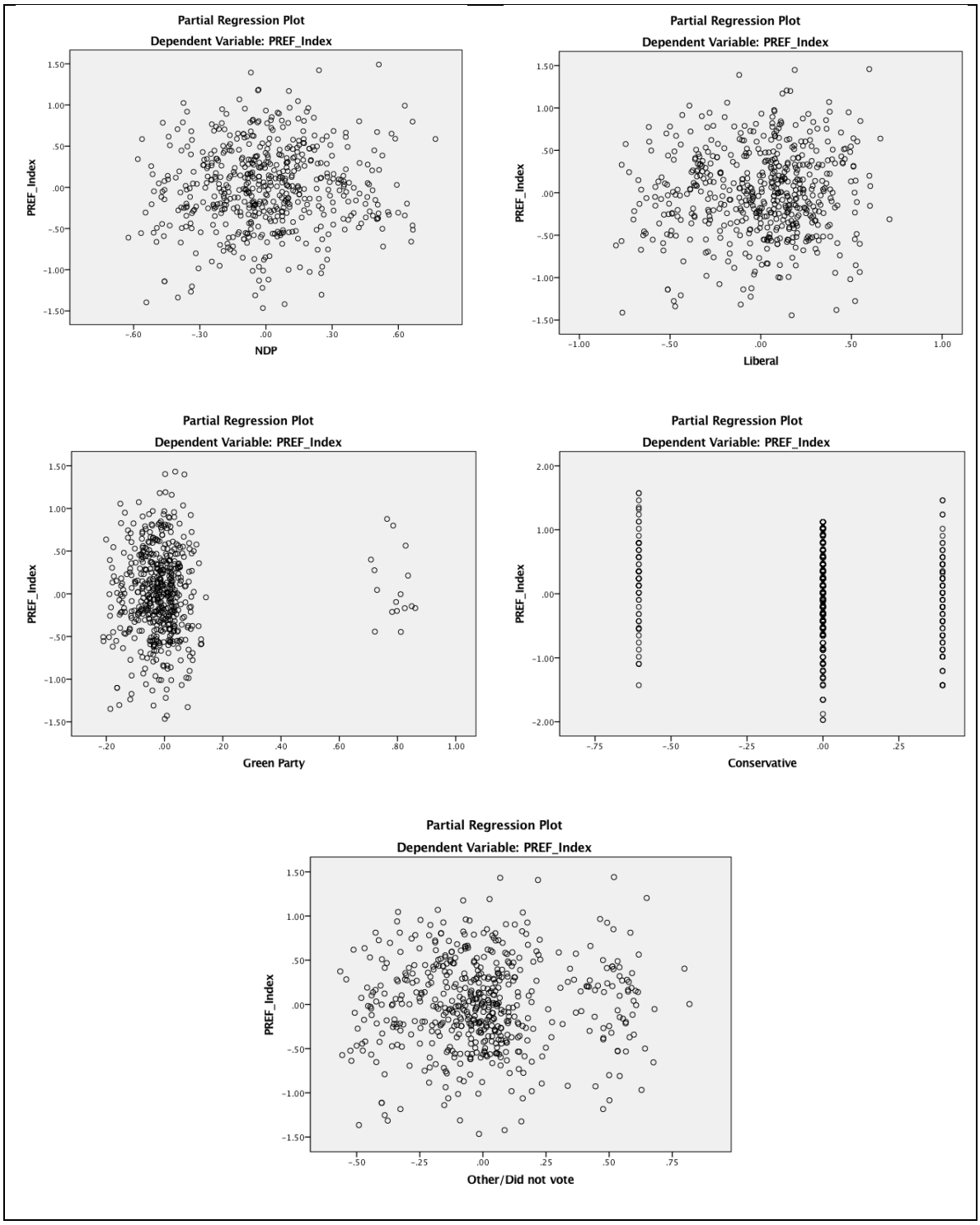

Figure 4**.** Partial regression plots for political party voted for and political ideology level against GHG Policy Index**.**

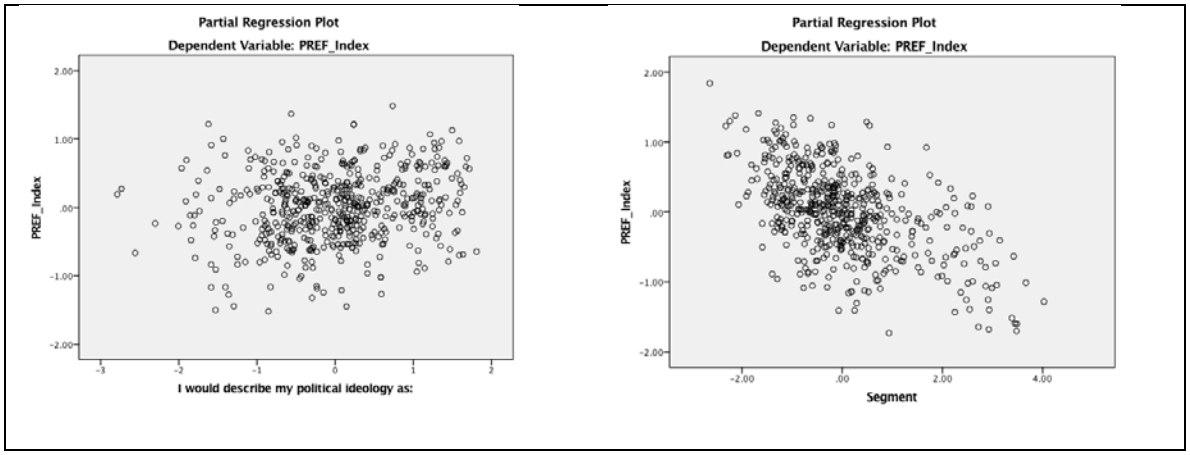

Figure 5. Partial regression plots for political ideology level as well as audience segmentation against GHG Policy Index.

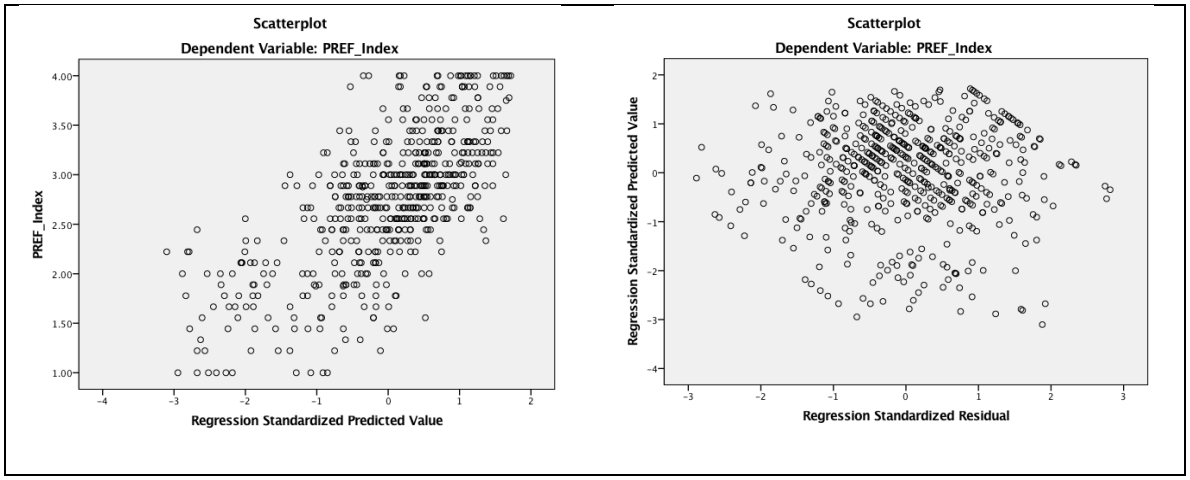

Figure 6. Scatterplots of GHG Policy Index against regression standardized.

Fourth, to ensure independence of observations and that the variables are not dependent on one-another, SPSS was used to calculate the Durbin-Watson statistic which was 1.996. Fifth, to test for homoscedasticity, the plot of residual against the expected was examined, and indicated that the error appears evenly distributed around the mean (Figure 7). Finally, to ensure that the residuals of the regression are normally distributed a

P-P plot was created using SPSS (Figure 8). From this plot it is apparent that the residual values are normally distributed around the predicted line.

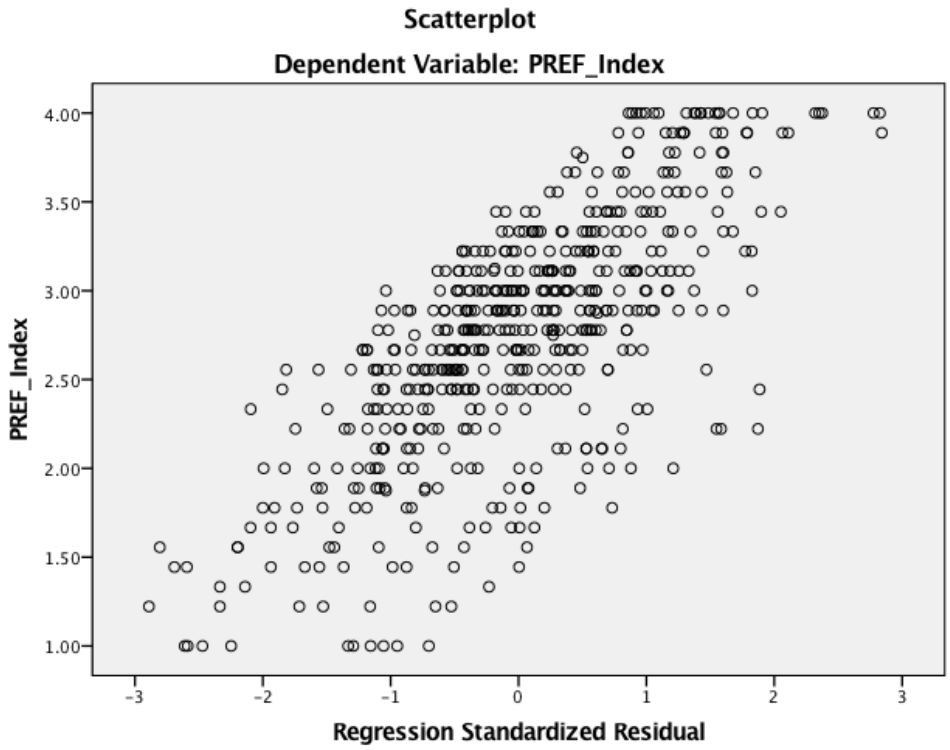

Figure 7. Scatterplot of GHG Policy Index against the standardized residual.

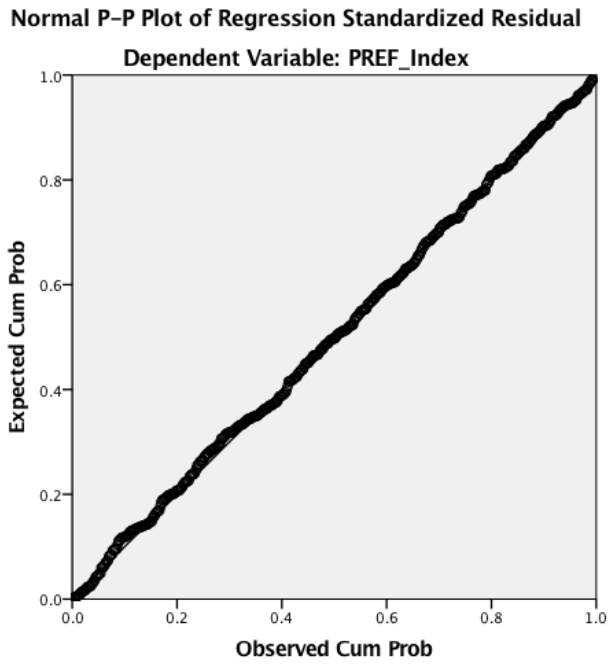

Figure 8. P-P Plot to test that residual errors are normally distributed.

Regression Model Results

Model 1 tested demographic characteristics of the respondents as predictors. An ANOVA for these variables showed that gender ($p<0.01$), region ($p<0.001$) and education-level ($p<0.01$) were significant predictors of the GHG Policy Index (Table 7). The remaining variables of age ($p=0.072$), annual income ($p=0.313$), employment status ($p=0.246$) and race ($p=0.221$) were not significant predictors and thus excluded from further analysis. All five regression models were calculated (Table 8). To further understand the impact of including the omitted demographic variables in the constant of Model l, regressions for the two dummy coded variables, Voting Behavior (Table 9) and Region (Table 10) were run independently as well.

Segmentation between Canada and the United States

To test the hypothesis that Canadians are similarly segmented in their views on climate change as Americans, a chi-square was used to test the segmentation against the latest Six Americas study with data collected in 2015 (Roser-Ranouf, 2016). The difference in segmentations is significant ($p<0.001$) and thus we reject the null hypothesis that they are similar (Table 11).

Table 7. ANOVA for demographic variables.

Question		df	F	Sig. (p)
Age	Between	5	2.038	0.072
	Within	545		
Gender	Between	1	7.141	0.008
	Within	549		
Location by Province/Region	Between	5	5.441	0.001
	Within	545		
Education level	Between	5	4.409	0.001
	Within	545		
Income	Between	3	1.189	0.313
	Within	547		
Employment status	Between	3	1.386	0.246
	Within	547		
Race	Between	5	1.405	0.221
	Within	545		
Political Ideology	Between	4	25.999	0.001
	Within	546		
Voting in last election	Between	4	23.524	0.001
	Within	546		

Table 8. Regression models for demographics, political ideology, voting behavior and audience segmentation as predictors of support for greenhouse gas reduction policies.

Variables	Model 1 Demogr.	Model 2 Political Ideology	Model 3 Voting behavior	Model 4 Audience Seg.	Model 5 Full Model
(Constant)	2.000	1.882	2.268	3.582	2.740
Gender (F=1)	0.166**				0.034
Region					
British Columbia	0.427***				0.138
Prairies	0.217				0.078
Atlantic	0.423**				0.116
Ontario	0.229*				-0.031
Quebec	0.450***				0.071
Eduction Level (1=no high school; 5=graduate degree)	0.091***				0.053**
Political Ideology		0.256***			0.108***
Voting Behavior					
Liberal			0.609***		0.110
NDP			0.702***		0.125
Green Party			0.801***		0.103
Other/Did Not Vote			0.405***		0.073
Audience Segmentation (1=Alarmed, 6=Dismissive)				-0.341***	-0.286***
Adjusted R^2	0.083	0.151	0.141	0.41	0.459
F	8.122***	98.982***	23.524***	380.867***	36.872***
N	551	551	551	551	551

Table format adapted from Maibach et al. (2011a)

Table 9. Linear Regression showing voting behavior in last Canadian federal election as predictor of GHG Policy Index.

Voting Behavior	B	Significance
Constant*	2.268	0.01
Liberal	0.61	0.01
NDP	0.70	0.01
Green Party	0.80	0.01
Other/Did not Vote	0.41	0.01
Adjusted R^2	0.048	
F	5.441	
N	551	

*Conservative is the omitted variable in the constant

Table 10. Linear Regression showing region of residence as predictor of GHG Policy Index.

Region	B	Significance
Constant*	2.44	0.01
British Columbia	0.43	0.01
Prairies	0.19	0.19
Atlantic	0.40	0.01
Ontario	0.22	0.02
Quebec	0.47	0.01
Adjusted R^2	0.048	
F	5.441	
N	551	

*Alberta is the omitted variable in the constant

Table 11. Chi-square test between climate change segments in Canada and the United States.

Segment	Canada Segmentation (%)	Canada Respondents	USA Segmentation (%)	USA Expected Respondents	Chi-square
The Alarmed	21	116	12	66	37.6
The Concerned	40	218	29	160	21.2
The Cautious	26	143	26	143	0.0
The Disengaged	2	12	7	39	18.3
The Doubtful	6	36	15	83	26.3
The Dismissive	5	26	11	61	19.8
Totals:	100	551	100	551	123.2

At 5 degrees of freedom, $p<0.001$

Chapter IV

Discussion

The primary question addressed by this research is whether Canadians are similarly segmented in their views on climate change as Americans. To answer this, an audience segmentation tool developed by Maibach et al. (2011a) was applied to survey data collected from a nationally representative sample of Canadian adults. This research set out to test the usefulness of this audience segmentation tool to identify distinct groups of Canadians who vary based on their beliefs in climate change, whether it is human-caused, and what they are willing to do to slow its progress, or to mitigate its effects. To test the predictive utility of the segmentation, this segmentation variable was used as a predictor of an index measuring support for greenhouse gas reduction policies (GHG Policy Index). As a basis of comparison, other demographic and behavioral attributes of the respondents were also used as predictors for the GHG Policy Index.

The Use of Audience Segmentation

This segmentation tool has been applied in the United States on multiple occasions (see Roser-Renouf et al., 2016 for latest) to identify the Six Americas of Climate Change. Variations have also been applied in Australia (Morrison, Duncan, Sherley & Parkon, 2013), India (Leiserowitz, Thaker, Feinberg & Cooper (2013), and Germany (Metag, Fuchsslin & Schafer, 2015) but to this researcher's knowledge this has

never been tested in Canada. A survey was sent to a nationally representative sample of Canadians based on age, gender and region of residence.

The purpose of audience segmentation is to identify distinct groups of people to whom we can target meaningful and actionable climate communications. This methodology is not unique to climate communications and has been used in multiple other fields. Public health, for example, has recognized that people will respond uniquely to different messages or motivators whether consequences, or social norms (Hornik, 2002). As Hornik (2002) points out we would be naïve to believe that people from one group would respond effectively to messages targeted at another. Similarly, political strategists have utilized audience segments to identify and focus on potential swing voters, while ignoring known supporters and ideological opponents whom they cannot turn (Sosnik, Fournier & Dowd, 2007). More recently, online and social media companies are using segmentation to target specific ads or content based on users' previous history and their online profiles (Hine et al., 2014).

With limited resources, climate communicators can ill afford to risk failure with costly attempts on blanketed climate communication strategies (Moser, 2014). Public engagement for scientists and policy makers aimed at reducing climate-harming behaviors poses challenges, particularly when there is a mismatch between the message and the audience (Hine et al., 2014). This mismatch can further undermine the message when it fails to resonate with or align with the values of audience (Moser, 2010). Audience segmentation provides policy makers and communicators with empirical information to help it advance its objectives through targeted engagement (Hine et al., 2014).

The Yale Team set out to create a segmentation tool that could be applied to independent population samples to identify "groups of people within a larger population who are homogenous with regard to critical attributes …. (beliefs, behaviors, political ideology) that are most relevant to a public education campaign" (Maibach et al. (2011a, p. 1). They provided a script to run in SPSS along with the specific segmentation questions and their coding (Miabach et al., 2011b). As described in the Results chapter the reduced discriminant tool was used in this research to mitigate scope and funding concerns for this study.

Survey Results

In February of 2016 the Six Canadas of Climate change were identified as the Alarmed (21%), the Concerned (40%), the Cautious (26%), the Disengaged (2%), the Doubtful (6%) and the Dismissive (5%) (Figure 1). Viewing the segments as a continuum, 87% of Canadians are thus Alarmed, Concerned or Cautious with respect to climate change, while only 13% are Disengaged, Doubtful or Dismissive. Given the potentially disastrous impacts of climate change this is perhaps a comforting finding, and yet Canada remains one of the highest emitters of GHGs per capita in the world (Pachauri et al., 2014) and the ninth highest emitter overall when it comes to fossil fuels (Olivier, et al., 2014). Thus, Canadians' beliefs on climate change do not necessarily inform their behaviors.

A series of chi-square tests validated that the survey was distributed to a nationally representative sample of Canadian adults by age group, region and gender (Tables 1-3). For each of these variables, the observed values were not significantly

different from the predicted values, and so we accept the null hypothesis that the samples are the same.

An ANOVA across the six segments tested the difference in means between segments for each of the segmentation questions and found them to be significant ($p<0.001$; Table 4). With the high F-values it is unlikely we could accept the null hypothesis across the actual distribution for any of the questions. In other words, the questions had significant predictive value in grouping individuals into the segments.

Motivations, Behaviors and Preferred Societal Responses

The between-segment variation on the segmentation questions is both significant ($p<0.001$) and telling of the characteristics of the Six Canadas. The certainty of global warming varies widely from 8.63 (scale=9) for the Alarmed, to 3.38 for the Dismissive (Table 5). Meanwhile the percent that agree that changes in climate owe primarily to human activities ranges from 91.4% for the Alarmed to 7.7% for the Dismissive. Likewise, previous worry about global warming, timing of potential harm to Canadians, and to future generations, and the personal importance of the issue follow a predictable downward pattern from the Alarmed to the Dismissive.

When asked how much prior thought they had given to global warming, those who were on the two poles of the segmentations, the Alarmed and the Dismissive, scored the highest. This finding was similar when they were asked how many of their friends shared their views on climate change. This raises the question of how much we live in an echo chamber, and surround ourselves with those who share our concerns and views. Some scholars have used “echo chambers” as a notion of how the information we value

has become a partisan choice, and how that information is used to reinforce rather than challenge our views (Jasny, Waggle & Fisher, 2015). In a world of connectedness through social networks and social media, it would be interesting in future research to understand how the sources of information we choose to receive, and that which we ignore, informs or validates our world-view.

Interestingly the responses to "how willing we are to change our opinion" were also very polarized, with the Alarmed and Dismissive most unwilling, while the other four segments were less steadfast in their views (Table 5). It is these more centrist segments that would therefore likely present communicators and policy-makers with the most receptive audience. They also arguably pose the greatest risk for being swayed by science-denying policy makers. While the Dismissive may be the most resistant audience, in Canada they make up only 5% of the population. Unfortunately, they may also be the most vocal and thus cannot simply be ignored.

When asked whether people should themselves do more or less to address global warming, the respondents followed the predictable pattern with the alarmed being the most agreeable. Interestingly however, when asked how often they punish companies for non-sustainable practices, most of the respondents had taken minimal action. The Alarmed took the most action saying they on average punished companies "a few times (2-3)" annually. However, there was little variance between the other segments with how often they punished corporations, even between the Concerned and the Dismissive. This raises a paradox where people say they should be doing more, while their behaviors do not reflect that. This finding is more a reflection of personal than corporate behavior, and validates the observation made earlier, that beliefs may not always inform behaviors,

even amongst the more concerned segments. With respect to the desired government action, a majority in all segments, other than Disengaged and the Dismissive, felt that climate change should be a priority for federal and provincial governments, and that this is not contingent on actions taken by other nations. This is a reassuring finding for policymakers wishing to enact climate mitigating strategies.

GHG Policy Index

After the audience segmentation questions, respondents were asked a series of nine ordinal questions that asked them to rank their level of support for various greenhouse gas (GHG) reduction policies from "Strongly Support" (4) to "Strongly Oppose" (1). The responses to these questions were then averaged for each segment to create a single "GHG Policy Index." The Cronbach's alpha for the policy questions was 0.90 suggesting a high internal consistency between the scores in the index. This compares favorably to the results of the earlier American study which had a Cronbach's alpha of 0.86 (Maibach et al., 2011a). The GHG Policy Index was then used as an outcome measure (y) for a series of regressions to assess the predictive utility of the segmentation (Maibach et al., 2011a). The hypothesis is that segment membership should predict level of support for climate policy as measured by the GHG Policy Index. Table 6 shows the willingness of respondents to accept these policies by segment.

The observed GHG Policy Index decreases as expected as respondents move between segments from the Alarmed to the Dismissive. One anomaly is noted in the index score for the Disengaged (N=12; index=2.70) which is unexpectedly slightly higher than that for the Cautious (index=2.44). Regression Model 4 (Table 8) demonstrates that

there is indeed a significant linear relationship between the six segments and the GHG Policy Index, and this is thus explained as sampling error.

There are, however, some interesting observations from this data on GHG policy support (Table 6). The Disengaged seem particularly supportive of GHG policies that involve government action such as subsidising efficient appliances in the home (question 17), adopting a carbon tax (18), require more renewable energy production (19), regulating fuel efficiency with automakers (23), and tax rebates for energy efficient vehicles (24). As Maibach et al. (2011a) noted when they ran the full discriminant model in the United States, the Disengaged were the most willing to change their minds about climate change. These individuals, although Disengaged, potentially represent a receptive audience for pro-environmental communications and policy.

Regression Model Development

A series of regression models were constructed to test the predictive utility of the audience segmentation method. Additional tests and models were created to also test other audience characteristics, namely their demographic information including age, gender, area of residence, household income, employment status and race, as well as political ideology and voting behavior in the last Canadian federal election. These additional models had the purpose of testing whether groups within these variables (e.g. male vs. female) were predictive of GHG mitigating policy support. They also served as a comparator to the Six Canadas audience segmentation to assess how well this segmentation explains the variation in policy support (R^2) compared to the measured demographics.

Demographic Findings

As many of the demographic variables were categorical, each was first tested with an ANOVA to determine whether there were significant differences between the means for these variables (Table 7). With the GHG Policy Index as the dependant variable, age ($p>0.07$), income ($p>0.31$) and race ($p>0.22$) had no significant difference in means for level of support for these policies in Canada. We thus accept the null hypothesis for these demographics and excluded them from further analysis. This was consistent with the results found by Maibach et al. (2011a) in the United States. In regression Model 1 where the remaining demographic variables of gender, region and education were combined, these demographic variables together ($R^2=0.083$) accounted for a little over 8% of the variance in the GHG Policy Index.

In Model 1, gender was a significant predictor of the GHG Policy Index. Specifically being female was significantly predictive ($B=0.166$; $p<0.01$) of increased support. The reason for this difference was not tested in this study, but it raises questions for future research. Are there specific values more commonly held by females that motivate support for positive climate initiatives? This does perhaps suggest that climate science communicators may benefit from targeting pro-environmental campaigns at certain Canadian men.

The results show that the region of residence for Canadians is a significant predictor of the GHG Policy Index. Although Canada has ten provinces and three territories, the populations between them differ vastly, with two of the provinces, Quebec (23.0%) and Ontario (38.5%), having over 50% of the population (Table 1). The four

sparsely populated eastern provinces (New Brunswick, Newfoundland & Labrador, Nova Scotia and Prince Edward Island) were grouped into a single "Atlantic" region, as were the two "Prairie" provinces (Saskatchewan & Manitoba). To conduct a regression on these categorical variables they were dummy-coded, with one group omitted to avoid issues of multicollinearity. Alberta was arbitrarily chosen as the reference group and it was thus reflected in the constant (B_0=2.00). Living in Quebec (B=0.450; $p<0.001$), British Columbia (B=0.427; $p<0.001$), the Atlantic Provinces (B=0.423; $p<0.01$) or Ontario (B=0.229; $p<0.02$) were all predictive of greater support for the GHG Policy Index over Alberta (Table 7). Living in the Prairie Provinces ($p>0.10$) was not significantly different from Alberta for the GHG Policy Index. This was true in the mixed-demographic Model 1 (where voting Conservative was also included in the constant), and also held when region alone was tested as a predictor of the GHG Policy Index (Table 10). This is perhaps not surprising given that Alberta is home to, and economically reliant on the Athabasca Tar Sands, and the Prairie provinces too rely on the fossil fuel industry for much of their economies. Testing this link, between fossil fuel driven economies and support for the GHG Policy Index, would be a potential topic for future research. It is interesting to note that the difference between Alberta and seven of the other Provinces is significant with respect to the GHG Policy Index, providing additional clues to where communication efforts could be focussed.

There were no respondents from Canada's three territories, Nunavut, Yukon and the Northwest Territories. Although these are the most sparsely populated areas in the country with less than 0.4% of the population (Statistics Canada, 2015b), they encompass a large northern landmass featuring permafrost and ice sheets. This area is largely

populated by indigenous peoples who rely on climate to ensure the migration of animals for hunting. The people in this area may potentially be highly impacted by anthropogenic climate change, and would thus be an interesting population to segment in a future study on views on climate change. The Maibach et al. (2011a) study did not report geographic area of respondents and thus there is currently no comparator to the Six Americas.

Education was the third demographic tested to be positively correlated with support for climate mitigating policies ($B=0.091$; $p<0.001$). Canadians with progressively more education were more like to support the policies. Thus developing strategies for focussing pro-environmental campaigns at less-educated voters could potentially be effective in increasing public support for GHG reduction policies. Note that the significance of education was not lost in the full model (Model 5; $p<0.01$) through interaction effects with the other variables, as it was in the Six Americas by Maibach et al. (2011a).

Past research has found that level of scientific knowledge and technical reasoning capacity are not predictive of climate change belief (Kahan et al., 2012), and education alone may not be enough to motivate pro-environmental behaviors (Corner & Groves, 2014). This study validates the findings of Hornsey et al. (2016) that education is positively correlated with belief in ACC. More research is needed to tease out why scientific knowledge and reasoning fail to predict climate change belief, while education level does. As a research question, perhaps there are aspects non-science fields of education such as arts, social science, or liberal arts that motivate support for positive climate policy.

Race, employment status and income were not significant predictors of policy support. This was the same finding in the American study (Maibach et al., 2011a). For this reason, these variables were removed from further analysis.

Political Ideology

Regression Model 2 compared a scale of political ideology from very right-wing conservative (1) to very left wing liberal (5) and was significant with respect to support for GHG Policy Index ($p<0.001$). Given prior research on the subject it is perhaps not surprising that support for GHG reduction policies decreases ($B= - 0.256$) as individuals move further to the right on the spectrum towards conservative values. In this study this regression model accounted for a little over 15% of the variance in policy support ($R^2=0.153$). It might also partly explain the regional differences in support, for example in Alberta where until 2015 the Alberta Conservative party of Alberta held a majority Provincial government for 44 continuous years. This finding aligns with the Six Americas study which found that this political ideology variable accounted for 12% of the variance in policy preferences (Maibach et al., 2011a). This also supports the findings of Hornsey et al. (2016) who found that political ideology was the largest demographic correlate for climate change belief.

Voting Behaviour in Last Federal Election

Regression Model 3 tested whether voting behavior in the 2015 Canadian federal election is predictive of the GHG Policy Index. Although the initial Six Americas study did not ask respondents about voting behavior, Canada's recent Federal election provided

an opportunity to assess whether voting behavior was predictive of the GHG Policy Index. An ANOVA showed significant differences ($p<0.001$; Table 7) between various party supporters on their willingness to support GHG mitigating policies. To conduct a regression, dummy-variables were therefore created for the categorical independent variables of political parties, with "Conservative Party of Canada" arbitrarily selected as the omitted comparator variable. Note that none of the respondents indicated support for the Bloc Quebecois which is a Quebec-based separatist party that received only 4.4% of the popular vote during the election (CBC, 2015). The regression showed that voters of the Liberal Party (B=0.609), the New Democratic Party (B=0.702), The Green Party (B=0.801) and those who selected "Other/Did not vote" were all significantly ($p<0.001$) more supportive on the GHG Policy Index compared to Conservative Party of Canada. This held when voting behavior was assessed as part of Model 1, with other demographic variables, and also when it was assessed on its own as a predictor of GHG Policy support (Table 9).

Canada's former Conservative Prime Minister, Stephen Harper, was widely known for his inaction on climate and his promotion of Canada's oil sands. When he first took power in 2006 he took significant steps to reduce commitments on CO_2 and GHGs and to ensure that Canada would not ratify the Kyoto Accord (Gutstein, 2014). Prime Minister Harper viewed environmental policies a threat to the economic security of Canada, while openly marketing Alberta's oil sands as "ethical oil" (Gutstein, 2014).

With the federal election of 2015, the new Liberal government has committed to improving Canada's record on the environment (Mildenberger et al., 2016). The results of this survey (not to mention the federal election) are telling that the anti-environmental

approach of the former government may not have resonated well with voters. Table 12 below shows how survey respondents voted in the last federal election according to their audience segment. Note that of the 62 respondents who were segmented as Doubtful or dismissive 36 (58%) were Conservative party voters. Of the 334 Alarmed and Concerned, the Conservatives made up only 12.6% (42) of the voters whereas the Liberals had 33% (111) and the New Democratic Party (NDP) had 22% (73).

Table 12. Number of votes received by each political party in 2015 Canadian Federal election by audience segment.

	Segment						Total
Voting in 2015 Canadian Federal Election	Alarmed	Concerned	Cautious	Disengaged	Doubtful	Dismissive	
The Conservative Party of Canada	6	36	39	3	18	18	120
The Liberal Party of Canada	6	105	64	5	10	2	242
The New Democratic Party	32	41	15	1	3	3	95
The Green Party of Canada	8	7	1	0	0	0	16
Other or did not vote	14	29	24	3	5	3	78
Totals:	116	218	143	12	36	26	551

Audience Segmentation

Compared to demographics, political ideology, and voting behavior, membership in audience segment was the most effective predictor of the GHG Policy Index. Along the continuum of the index (Strongly Support =4; Strongly Oppose =1) respondents follow a predictable path of decreasing support from the Alarmed (GHG Policy Index =3.35) to the Dismissive (GHG Policy Index=1.59) (Table 6). Regression Model 4 tested the strength of this relationship with the GHG Policy Index again as the outcome measure and segment membership as the independent variable. The results showed that segmentation significantly predicts the GHG Policy Index ($p<0.001$; Table 7). Furthermore, segment membership accounts for 41% of the variation (adjusted $R^2=0.41$) in the policy index (Table 8). Interestingly this is the identical result obtained by Maibach et al. (2011a) when they developed this model and tested its utility in this way. Audience

segmentation therefore explains significantly more of the variation in the GHG policy index than demographics (adjusted R^2=0.083), political ideology (adjusted R^2=0.151) or voting behavior in the last federal election (adjusted R^2=0.141).

The Full Model

Regression Model 5 was the full model, testing all of the predictor variables in the first four models. This model predicts a little over 45% the variance in the GHG Policy Index (R^2=0.459). In this model, education ($p<0.01$), political ideology ($p<0.001$) and segmentation ($p<0.001$) were still highly significant predictors of the GHG Policy Index in the Six Canadas of climate change, while gender and area of residence were no longer significant predictors. This differs slightly from the Six Americas where none of the demographic variable remained significant predictors in the full regression model. In the Canadian model gender, area of residence and even voting behavior were no longer significant with the interaction of all of these variables together. This could be due to an interaction or moderation effect with other variables. Note that level of education remained significant even in the full model.

Comparison to the Six Americas

This research set out to test whether Canadians are similarly segmented in their views on climate change as Americans. The latest Six Americas Segmentation was released in early 2016 and summarizes data collected in the spring of 2015 (Roser-Renouf et al., 2016). The latest Six Americas of Climate Change are the Alarmed (12%), the Concerned (29%), the Cautious (26%), the Disengaged (7%), the Doubtful (15%) and

the Dismissive (11%). A chi- square analysis (Table 11) was used to test the Six Canadas to the expected proportion of the Six Americas. The difference in segments across the countries was significantly different ($p<0.001$), and thus we reject the null hypothesis that the countries are similarly segmented in their views on climate change. From Table 11 we can see that Canadians are better represented in the Alarmed and Concerned segments, while Americans populated the Disengaged, Doubtful and Dismissive segments more than the Canadians. The two countries had an identical proportion of the Cautious.

Given the similarities between Canada and the United states, who are each other's largest trading partners and closest neighbors, this is an interesting result. It is also interesting to note that the two countries had the same statistically significant demographic predictors of the GHG Policy Index, namely gender, education and political ideology. The American study did not report regional statistics (state or region of residence), which were significant in Canada. In neither country were age, income, employment status or race, predictors of the GHG Policy Index.

In the Six Americas gender and education were not significant when assessed simultaneously with other predictors in the full regression model. In Canada however, education level remained a significant predictor in the full model (regression Model 5) with a small but notable Beta coefficient ($B=0.05$; $p<0.01$). Whether level of education, or the content delivered varies between the two countries would be an interesting focus for future research. The descriptive statistics of Canadian's education level by segment are shown in Table 11. The same descriptive statistics were not provided in the Six Americas literature.

Table 13. Education level of Canadians by audience segment.

	Segment						Total
Education Completed	Alarmed	Concerned	Cautious	Disengaged	Doubtful	Dismissive	
No high school	1	1	3	1	0	0	6
High school diploma	18	39	30	3	6	10	106
Post-secondary certificate or CEGEP	21	42	39	2	15	5	124
2-year post-secondary diploma	18	30	20	2	5	1	76
Undergraduate	39	61	32	1	1	6	140
Graduate degree	19	45	19	3	9	4	99
Totals	116	218	143	12	36	26	551

A recent study of teachers in the United States may shed some light on this from one side of the border. Plutzer et al. (2016) found that there is significant confusion amongst science teachers in the United States regarding the existence and etiology of climate change. This study, which surveyed 1500 teachers in 50 states, found significant variation in the teaching on the level of scientific consensus. They found that the variation in teaching came from 1) overt pressure to not teach climate science, 2) lack of knowledge over a wide range of evidence; and 3) lack of clarity on the scientific consensus, where only 30% of middle school and 45% of high school teachers correctly identified the true level of consensus (Plutzer et al., 2016). Most interestingly, they found that teachers' political ideology was a greater predictor of their approach to teaching climate change than their knowledge (Plutzer et al., 2016.).

Gender was significant in both countries with females being significantly more likely to support GHG mitigating policies than males. This significance was diminished in both countries when gender was included as part of the full regression models. Political ideology was significant in both countries when measured as a single predictor of the GHG policy index, and also in the full regression model. As a single predictor, ideology had moderate explanatory power for the variance in the GHG Policy Index in Canada (15%; Table 7) and in the United States (12%; Maibach et al., 2011a).

Given that both countries share gender, education-level and political ideology as significant predictors of the GHG Policy Index, it raises the question why the segmentations are significantly different. Are there more conservatives in the Untied States? Are education levels or programming significantly different? Are there differences in the individualistic or egalitarian values between these two countries? Having this cross-border comparison now provides a framework for future research to explain the significant differences in climate change belief across the Canada – United States border.

The Segmentation Tool

In developing the segmentation tool Maibach et al. (2011a) used a latent class analysis (LCA) modeling technique to identify distinct latent classes, or segments. In this process they evaluated models that had five, six and seven segments, but settled on six based on this model's fit and interpretability (Maibach et al., 2011a). The intention of these researchers was to develop "a survey-based identification tool that can be used to identify audience segments in independent population samples with acceptable levels of

accuracy" (Miabach et al., 2011a, p. 2). Over 306 variables were tested in order to develop the 36 question "full discriminant model" that allows for independent sampling of populations to determine audience segmentation. The 15 question "reduced discriminant model" which was used here also allows this sampling by eliminating the 21 least predictive variables. It was not within the scope of this research to assess the validity of the previous researcher's Latent Class Analysis or selection of six segments.

Some researchers have cautioned that a segmentation tool such as the one developed by Maibach et al. (2011a) has limitations. Hine et al. (2014) for example argue that such an approach implicitly assumes that individuals can move between segments over time, but that the segments themselves never change. This objection has some merit and is discussed further below under Future Research. Perhaps a bigger objection is the lack of research that tracks how effectively segmentations have been used in climate communications to specifically target problem behaviors, and how effective those are compared to other modalities of public engagement (Hine et al., 2014). This is not necessarily as much of an objection to the segmentation methodology, as it is an opportunity to take this research forward. Hine et al. (2014) are correct to be concerned about the lack of research linking segments to effective campaigns. This is where segmentation studies will need to focus their efforts, and that is discussed more below.

The predictive utility of this segmentation tool was demonstrated in this study. A regression found the segmentation to be the most powerful predictor of the variance in support for the GHG Policy Index (Table 8; R^2=0.41). It was significantly more powerful than any demographics, political ideology or voting behavior alone. There are undoubtedly improvements that can be made to the segmentation tool, and by continuous

application of the scientific method we can monitor its effectiveness and value over time. In this type of social science research it should be noted that the tool need not have extreme precision to guide communicators and policy makers in developing interventions to change behaviors within certain segments of the population. Segmentation allows for more targeted interventions than a blanket "carpet-bomb" approach that can be empirically tested, despite inevitable variations within a group.

Recent Research

The most recent research utilizing the Six Americas methodology was released in February of 2016 (Roser-Renouf et al., 2016). In this study the investigators explored the link between faith, morality and the environment amongst the Six Americas. They hypothesized that reframing climate change as a moral and religious issue, rather than a scientific one, may resonate more with Americans who are amongst the most religious citizens in the industrialized world (Roser-Renouf et al., 2016). Their findings suggest that a moral framing of the issue would resonate more powerfully with unconcerned segments than would scientists with figures and data. Roser-Renouf et al. (2016) noted that a majority within all segments other than the Alarmed would weigh religious information over scientific information of the two were ever in conflict. Thus in the United States where a sizable portion of the population has doubts about climate change, framing climate policy within a religious or moral framework may help with moving people to more climate-supporting segments.

While audience segmentation is in its relative infancy with respect to climate communications, this type of study demonstrates the power of this methodology. The

segmentation in this report provides some key insights into the values of these segments such as which groups are more egalitarian or individualistic. Using this information, researchers can begin to test communication strategies on these segments and then measure the effects of their interventions. Linking the effects of reducing GHGs to helping reduce drought in developing nations may for example motivate segments that have egalitarian values. Showing the potential economic benefits of green energy may motivate segments with individualistic values. The segmentation itself is a useful tool, but perhaps the most pressing area of research is how to use it to move people between the segments to more pro-environmental behaviors.

Climate Opinion in Canada

Interestingly on February 15, 2016, the day the Six Canadas survey closed, another team released findings on climate change public opinion in Canada by region (Mildenberger et al., 2016). While they found that a full 79% of Canadians believe that the climate is changing, only 44% believe it is caused mostly by human activities. Given the different framing of their questions, a direct comparison of these values to the Six Canadas study is challenging. Perhaps the most interesting finding is the diversity of opinion on climate change at local levels. They found the strongest support for climate change is in coastal areas and urban areas, whereas it is the lowest in rural areas. Of the ten federal electoral districts with the lowest belief in climate change, seven were in Alberta, and the other three were in Saskatchewan (2) and Manitoba (1) (Mildenberger et al., 2016). This aligns with the findings of the Six Canadas study which found Alberta and the Prairie Provinces to have the lowest support for GHG reduction policies.

Like this current Six Canadas study, Mildenberger et al. (2016) found Canadians believe that climate change is happening at higher levels than Americans do. They also found that Canadians have widespread support for climate mitigating policies with emissions trading the most highly supported, with majority support in every single Canadian electoral district. On the other hand, Canadians are more divided over carbon taxation which is consistent with this current study.

Future Research

This study applied a segmentation tool to a representative sample of the Canadian population to categorize individuals into distinct segments based on their views on anthropogenic climate change. The study further went on to test and validate the predictive utility of this tool in accounting for support of a GHG Policy Index and determined that segment membership was a significant predictor of policy support. Having this knowledge builds on similar studies conducted in the United States, Australia, Germany and India and supports future comparisons between these countries. This research provides a framework to support future studies in Canada to help climate communicators better understand their audience in crafting effective interventions to promote more pro-environmental behaviors. Future research in this area should include ongoing segmentation analysis as well as measuring the effectiveness of tailored communications for each segment, or even for members within segments. Most importantly such research needs to not only focus on changing beliefs, but more importantly modifying behaviors.

Ongoing Segmentation Analysis

This research provides a baseline for the segmentation of Canadian's view on climate change. Repeating this study periodically will enable us to monitor Canadians' beliefs and behaviors around climate change over time, and whether Canadians are moving between segments. This could serve as a pulse-check on Canadian's views and provide policy makers and communicators with intelligence for crafting policy and strategies. There are objections to this type of research as noted above, namely that it assumes that movement only happens between segments and that the segments themselves remain static (Hine et al., 2014). This is a valid objection that warrants vigilance an monitoring. But this does not take away the value of using this as a tool for monitoring views over time, and for targeting interventions at specific segments. As noted these segmentations do not necessarily demand scientific precision to be effective tools for designing and measuring interventions. Empirical data and information from these studies will inform the value of pursuing these methods over time.

Although segmentation has been used in other research areas, such as marketing and health for years, segmentation for climate communications is still in its relative infancy. The results in this study have demonstrated the effectiveness of this reduced discriminant segmentation tool in identifying unique groups of individuals in a population with respect to their beliefs, motivations and behaviors around climate change. It has demonstrated with significance that these groupings accurately predict in a linear fashion, support for the GHG Policy Index. Having this segmentation and utilizing it concurrently across borders enables us to test theories that account for differences between these countries.

We have seen for example that education and political ideology were significant predictors of the GHG policy index in both Canada and the United States, but that are our segments are statistically different. Armed with this information we can now begin to design experiments to evaluate the institutional differences in our educational and political systems to determine if they will reveal actionable knowledge to improve environmental behaviors.

Tailoring Climate Communications

There is seemingly limited research on how specific audience segments respond various types of climate communications. Haidt (2012) has found that appeals to reason may have a boomerang effect even when empirical facts run counter to the inherent moral values of individuals. Climate communications must therefore be well conceived if their intent is to positively modify behaviors. Hine et al. (2013) similarly found that individuals in various segments responded more favorably to messaging that is framed to align with their values. They found for example that those who were undecided on climate change were more receptive to messages that are emotional or that focus on loss prevention (Hine et al., 2013).

Similar studies from health have shown that tailoring messages to specific segments can have positive impacts with health behavior interventions (Noar, Benac & Harris, 2007). Skinner, Campbell, Rimer, Curry & Prochaska (1999) found that tailored communications are better remembered as relevant and credible than non-tailored ones. Rimer and Glassman (1999) similarly found that tailored communications were effective in modifying behaviors in cancer patients than non-tailored ones.

With Canadians now segmented in their views on climate change, future research should focus on identifying how to tailor communications interventions that are the most effective for modifying behaviors by audience segment. By empirically testing the effectiveness of certain interventions (e.g. appeal to sense of community, moral or religious duty, egalitarian values, economic consequences) by segment, research can begin to test which interventions most effectively modify most effective for each population. Measurements must be set up to track the effectiveness of these interventions in causing migrations across segments, and more importantly improving pro-environmental behaviors.

Motivating Pro-Environmental Behaviors

Residents of the most developed nations tend to be some of the highest emitters of GHGs per capita (Olivier et al., 2014). Even within Alarmed and Cautious segments, individuals may be well aware of the threats of climate change, while their daily behaviors may counter to that. It was noted earlier that the United States and Canada are some of the highest emitters of fossil fuels, despite having sizable populations that are at least aware of the consequences of climate change. Whether it is by taking long showers, flying excessively, heating large homes or driving large cars it is clear that knowing and willing, do not always lead to doing. This study found that people in most segments, other than the Doubtful and the Dismissive, agreed that people should do more to mitigate climate change. When asked about personal actions taken, most segments other than the Alarmed were doing little themselves (Table 6). More research is therefore

needed to better understand the gap between knowledge and action, and what motivators would entice individuals to minimise their carbon footprint.

It was noted in this study that while the Alarmed and the Dismissive are the least likely to change their minds about climate change, the other segments were more open to change. The Disengaged and the Cautious were the most open to changing their views and together they represent 28% of the sample population (Figure 1). They might therefore serve as a suitable initial audience for experimental interventions aimed at improving behaviors. The other segments cannot be ignored however. Members of the Dismissive are some of the most vocal and polarized audiences, and thus efforts at appealing to their values to neutralize some of their scientific skepticism may have potentiating effects by limiting the spread of their anti-scientific views.

Targeting Albertans, Prairie Provinces and Conservatives

The regression models showed that Albertans were statistically less likely to support GHG reduction polices than most other residents of Canada (Table 8), other than the Prairies (Manitoba and Saskatchewan). Alberta is well known for its Athabasca tar sands which play a substantial role in the economic prosperity of its citizens. Future research could focus on what interventions might help Albertans move between segments to being more accepting of climate change. Alberta's economy is heavily reliant on fossil fuels, and thus research to help stimulate alternate energy development such renewables, or a more diversified economy could potentially shift views in this province. Albertans and other Canadians may feel conflicted between the need to act on climate and the economic incentives this nation receives from non-renewable energy production.

Similarly, Conservative voters in the 2015 Canadian federal election were significantly lower on the GHG Policy Index than all other parties. Gutstein (2014) argues that climate science denial is well embedded in the conservative ideology in Canada. Conservative funded think tanks like the Fraser Institute regularly publish research debunking climate science (for example Green, 2014) or GHG mitigating polices (for example Jackson & Eisen, 2015).

Future research could focus on improving the trust the public has in science. The political right has seen success with communications that debunk science. This messaging enables Canadians to fuel their desires to profit from energy production, and perhaps to feel less need to take personal actions to reduce their carbon footprints. Additional research could therefore test the efficacy of promoting the economic benefits of becoming leaders in renewable development, especially in Alberta and the prairie provinces where the stakes of weaning off the tar sands economy is high.

Chapter V

Summary and Conclusions

There is little doubt within the scientific community about the need for immediate action to reduce the magnitude and impacts of ACC. To effectively reduce carbon and other greenhouse gas emissions effective climate solutions will require the engagement and collective action of millions of people and thousands of organizations in the United States and other countries including Canada. Unfortunately, there remains a gap between scientific knowledge and action from the general public.

This study tested a discriminant segmentation tool to classify a nationally representative sample of Canadians into six distinct groups, homogenous in their beliefs, behaviors and preferences with respect to climate change. Audience segmentation is a methodology that has long been used to efficiently target communications to distinct groups of people based on their values, beliefs and motivations. This segmentation-tool groups citizens into segments that represent a continuum of belief in climate change, from the Alarmed – who believe climate change is a clear an imminent threat, to the Dismissive who largely reject the claims made by science.

The segmentation tool successfully classified Canadians into six segments. The proportion of Canadians in each segment was significantly different than that of Americans. The effectiveness of these segments was validated by using the segments as predictors of a GHG Policy Index. The study additionally identified some demographic variables that were predictive in level for support for GHG policies and these included

gender, political ideology and voting behavior in the last Canadian federal election. Specifically, it found that being male, a resident of Alberta, or a Conservative Party member is statistically predictive of less support for the GHG Policy Index.

Segmentation was the most significant predictor of support for the GHG Policy Index explaining 41% of the variance in this variable. This was much more powerful than the demographic model (8%) or political ideology (15%). Communications or polices that move people between segments towards the Alarmed, are therefore powerful tools to improve support for GHG mitigating policies. An interesting finding was that even amongst those who say we should take more action, their own consumer behaviors did not necessarily reflect their views.

Segmentation provides communicators and policy makers with guidance on where to direct communication and research efforts. For the future, this tool and methodology provides a baseline and a framework to measure how Canadians view climate change over time, along with a basis for comparison with the United States. We can use that comparison to determine key differences between these two countries, and why, despite having the same predictors for policy support, the populations are segmented differently.

Future research can use segments to empirically test the effectiveness of various communication strategies to improve belief within targeted homogenous populations. More importantly, through understanding the distinct values of the people within these segments interventions must be tested that will improve the pro-environmental behaviors of these groups, further closing the gap between belief and action.

Appendix

Survey Questions and Response Coding

Question #	Label	Question Stem	Responses and coding	Recoding and missing data treatment
1	Belief1	Recently you may have noticed that global warming has been getting some attention in the news. Global warming refers to the idea that the world's average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world's climate may change as a result. What do you think? Do you think that global warming is happening?	1. Extremely sure global warming is not happening 2. Very sure global warming is not happening 3.Somewhat sure global warming is not happening 4. Not at all sure global warming is not happening 5. Don't know 6. Not at all sure global warming is happening 7. Somewhat sure global warming is happening 8.Very sure global warming is happening 9.Extremely sure global warming is happening	Calculate mean and substitute for missing data
2	Belief2	Assuming global warming is happening, do you think it is ...	1. Caused mostly by human activities 2.Caused mostly by natural changes in the environment 3.Other 4.None of the above because global warming isn't	This variable is recoded into three dummy variables. "Other" is the omitted response category.

Question #	Label	Question Stem	Responses and coding	Recoding and missing data treatment
			happening	Recoding of missing data on this item: if respondent said global warming is not occurring on Belief1, respondent is coded as 4; if respondent said global warming is occurring on Belief1, s/he is coded as 1. The remainder are recoded as 3.
3	Inv15	How worried are you about global warming?	1.Not at all worried 2.Not very worried 3.Somewhat worried 4.Very worried	Calculate mean and substitute for missing data
4	Belief4	How much do you think global warming will harm you personally?	0.Don't know 1.Not at all 2.Only a little 3.A moderate amount 4.A great deal	Calculate item mean excluding "don't know" responses & substitute for missing data. This variable is recoded into dummy variables for discriminant analysis within the SPSS and SAS syntax. "Only a little"

Question #	Label	Question Stem	Responses and coding	Recoding and missing data treatment
				is the omitted response category.
5	Belief7	When do you think global warming will start to harm people in Canada? *Original American Question: When do you think global warming will start to harm people in the United States?*	1.Never 2.In 100 years 3.In 50 years 4.In 25 years 5.In 10 years 6.They are being harmed now	Calculate mean and substitute for missing data
6	Belief5	How much do you think global warming will harm future generations of people?	0.Don't know 1.Not at all 2.Only a little 3.A moderate amount 4.A great deal	Calculate item mean excluding "don't know" responses & substitute for missing data. This variable is recoded into dummy variables for discriminant analysis. "Only a little" is the omitted response category.
7	Inv16	How much had you thought about global warming before today?	1.Not at all 2.A little 3.Some 4.A lot	Calculate mean and substitute for missing data
8	Inv18	How important is the issue of global warming to you personally?	1.Not at all important 2.Not too important 3.Somewhat important 4.Very important 5.Extremely important	Calculate mean and substitute for missing data

Question #	Label	Question Stem	Responses and coding	Recoding and missing data treatment
9	Inv19	How much do you agree or disagree with the following statement: "I could easily change my mind about global warming."	1.Strongly agree 2.Somewhat agree 3.Somewhat disagree 4.Strongly disagree	Calculate mean and substitute for missing data
10	Inv22	How many of your friends share your views on global warming?	1.None 2.A few 3.Some 4.Most 5.All	Calculate mean and substitute for missing data
11	Belief8	Which of the following statements comes closest to your view?	1.Global warming isn't happening. 2.Humans can't reduce global warming, even if it is happening. 3.Humans could reduce global warming, but people aren't willing to change their behavior so we're not going to. 4.Humans could reduce global warming, but it's unclear at this point whether we will do what's needed. 5.Humans can reduce global warming, and we are going to do so successfully.	Calculate mean and substitute for missing data
12	PSR34	Do you think citizens themselves should be doing more or less to address global warming?	1.Much less 2.Less 3.Currently doing the right amount 4More 5.Much more	Calculate mean and substitute for missing data
13	Behavior	Over the past 12 months, how many times have you punished	0.Don't know 1.Never	Calculate item mean

Question #	Label	Question Stem	Responses and coding	Recoding and missing data treatment
	25	companies that are opposing steps to reduce global warming by NOT buying their products?	2.Once 3.A few times (2-3) 4.Several times (4-5) 5.Many times (6+)	excluding "don't know" responses & substitute for missing data. This variable is recoded into dummy variables for discriminant analysis. "Once" is the omitted response option.
14	PSR 32	Do you think global warming should be a low, medium, high, or very high priority for the Parliament and Provincial Legislatures? *Original American Question:*	1.Low 2.Medium 3.High 4.Very high	Calculate mean and substitute for missing data
15	PSR 36	People disagree whether Canada should reduce greenhouse gas emissions on its own, or make reductions only if other countries do too. Which of the following statements comes closest to your own point of view? Canada should reduce its greenhouse gas emissions ... *Original American Question: People disagree whether the United States should reduce greenhouse gas emissions on its own, or make reductions only if other countries do too. Which of the following*	0.Don't know 1.Canada should not reduce its emissions (1.The United States should not reduce its emissions) 2.Only if other industrialized countries and developing countries (such as China, India and Brazil) reduce their emissions 3.Only if other industrialized countries (such as the United States, England, Germany and Japan) reduce their	Calculate item mean excluding "don't know" responses & substitute for missing data. This variable is recoded into dummy variables for discriminant analysis within the SPSS and SAS syntax. "Only if other industrialized

Question #	Label	Question Stem	Responses and coding	Recoding and missing data treatment
		statements comes closest to your own point of view? *The United States should reduce its greenhouse gas emissions ...*	emissions *(3.Only if other industrialized countries (such as the England, Germany and Japan) reduce their emissions)* 4.Regardless of what other countries do **American responses italicized above**	countries reduce" is the omitted response option.
16	PREF1	Establish a special fund to help make buildings more energy efficient and teach Canadians *(Americans)*how to reduce their energy use. This would add a $2.50 surcharge to the average household's monthly electric bill.	For each of the questions PREF1-PREF9 use the following scale and coding. 1. Strongly oppose 2. Oppose 3. Support 4. Strongly support	Calculate mean by segment and substitute missing data.
17	PREF2	Provide a government subsidy to replace old water heaters, air conditioners, light bulbs, and insulation. This subsidy would cost the average household $5 a month in higher taxes. Those who took advantage of the program would save money on their utility bills.		Calculate mean by segment and substitute missing data.
18	PREF3	Adopt a carbon tax scheme (on carbon dioxide - the primary greenhouse gas) that applies to all polluters of carbon-whether individuals or businesses.		Calculate mean by segment and substitute missing data.
19	PREF4	Require electric utilities to produce at least 20% of their electricity from wind, solar, or other renewable energy sources, even if it cost the		Calculate mean by segment and substitute

Question #	Label	Question Stem	Responses and coding	Recoding and missing data treatment
		average household an extra $100 a year.		missing data.
20	PREF5	Sign an international treaty that requires (*The United States*) Canada to cut its emissions of carbon dioxide 90% by the year 2050.		Calculate mean by segment and substitute missing data.
21	PREF6	Require automakers to increase the fuel efficiency of cars, trucks, and SUVS, to 45 mpg, even if it means a new vehicle will cost up to $1,000 more to buy.		Calculate mean by segment and substitute missing data.
22	PREF7	Fund more research into renewable energy sources, such as solar and wind power.		Calculate mean by segment and substitute missing data. Calculate mean by segment and substitute missing data.
23	PREF8	Provide tax rebates for people who purchase energy-efficient vehicles or solar panels.		Calculate mean by segment and substitute missing data.
24	PREF9	Increase taxes on gasoline by 8 cents per liter and return the revenues to taxpayers by reducing the federal income tax.		Calculate mean by segment and substitute missing data.
25	DEM1	*(*Note many of these demographic questions were not asked in the Six Americas study. These were constructed specifically for this study)*	1.18 to 24 years 2. 25 to 34 years 3.35 to 44 years 4.45 to 54 years 5. 55 to 65 years	Leger Survey has under 198 option which clicks them

Question #	Label	Question Stem	Responses and coding	Recoding and missing data treatment
		My age is:	6. 65+ years	out of survey
26	DEM2	I primarily identify as:	1. Female 2. Male	
27	DEM3	My primary residence is in:	1. Alberta 2. British Columbia 3. Manitoba 4. New Brunswick 5. Newfoundland 6. Nova Scotia 7. Ontario 8. Prince Edward Island 9. Quebec 10. Saskatchewan 11. Territories	
28	DEM4	My highest level of education completed is:	1.No high school 2.High school diploma 3.Post-secondary certificate or CEGEP 4.2-year post-secondary diploma 5.Undergraduate degree 6.Graduate degree	
29	DEM5	My annual household income level is (including all members of household):	1.Less than $50,000 2.$50,000 to 100,000 3.$100,001 to $150,000 4.$150,000+	
30	DEM6	My current employment status is:	1.Not employed 2.Part-time 3.Full-time 4.Retired	
31	DEM7	I primarily identify myself as	1.White 2.Hispanic 3.Asian	

Question #	Label	Question Stem	Responses and coding	Recoding and missing data treatment
			4.Black 5.First Nations/ Metis/ Inuit 6.Other	
32	DEM8	I would describe my political ideology as:	1.Very conservative (right wing) 2.Somewhat conservative (right of centre) 3.Centrist (neither right nor left wing) 4.Somewhat liberal (left of centre) 5.Very liberal (left-wing)	
33	DEM9	In the last Federal election I voted for a candidate from:	1.The Conservative Party of Canada 2.The Liberal Party of Canada 3.The New Democratic Party (NDP) 4.The Green Party of Canada 5.The Bloc Quebecois 6.Other or did not vote	

Questions were taken from Maibach et al. (2011b) and adjusted for the Canadian audience.

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